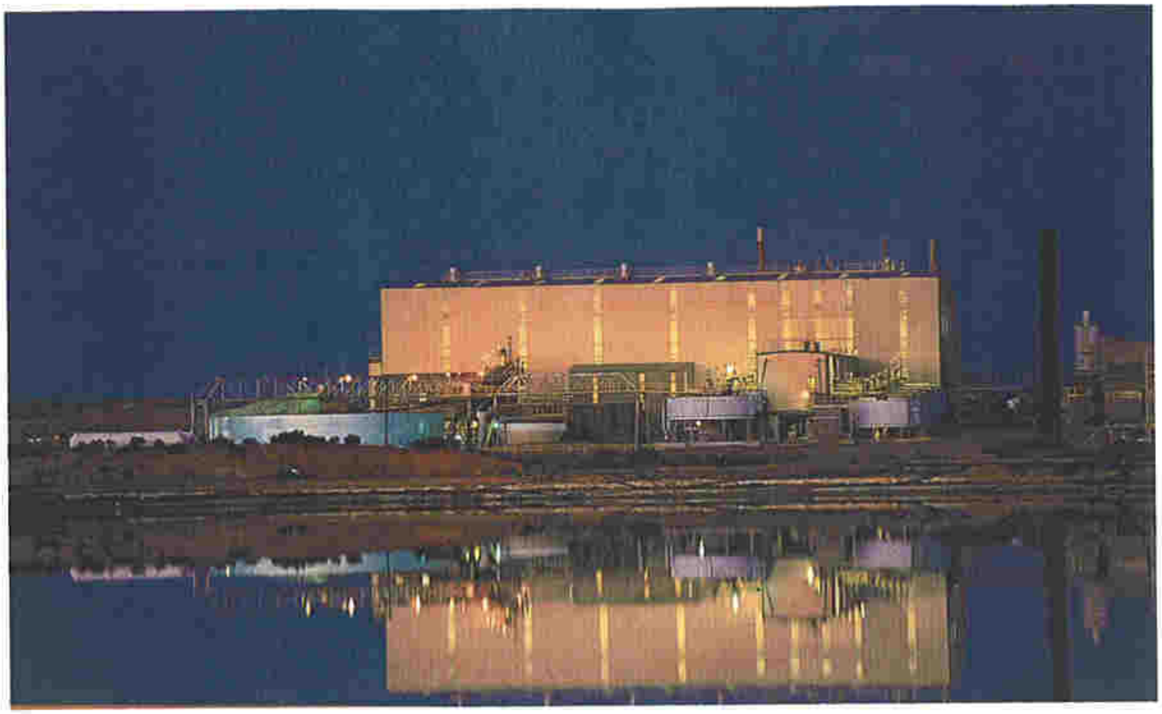

WHITE MESA URANIUM MILL

LICENSE RENEWAL APPLICATION

STATE OF UTAH RADIOACTIVE MATERIALS LICENSE No. UT1900479

February 28, 2007

Prepared By:
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Volume 4 of 5
(Environmental Report)

WHITE MESA URANIUM MILL
Environmental Report
In Support of the License Renewal Application

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1. INTRODUCTION

Denison Mines (USA) Corp. ("Denison") operates the White Mesa Uranium Mill (the "Mill"), located approximately six miles south of Blanding Utah, under State of Utah Radioactive Materials License No. UT1900479 (the "License"). This Environmental Report ("ER") has been prepared to accompany and support Denison's License Renewal Application (the "Application") for renewal of the License under Utah Administrative Code R313-22-37.

This ER describes the environment in which the Mill operates, the environmental and radiation monitoring results to date, and the potential for future impacts to public health, safety and the environment. This ER demonstrates that the Mill has been operating in compliance with all applicable regulatory standards and ALARA (as low as reasonably achievable) goals, and that continued operation of the Mill in accordance with the existing terms and conditions of its License will not be inimical to public health, safety or the environment.

1.1. The Proposed Action

The proposed action is the renewal of the License on the same terms and conditions as set forth in the existing License. Denison plans to continue operating the Mill on these same terms and conditions. Accordingly, the Application and this supporting ER serve to supplement, and update as necessary, already existing and accepted analyses of the facility.

1.2. Purpose and Need for the Proposed Action

The Mill is licensed to process natural uranium ore and certain alternate feed materials. The purpose of the Mill's process is to extract contained uranium and co-product metals, such as vanadium, from such ores. The current License is up for renewal on March 31, 2007. It is the purpose of this ER to support Denison's Application to renew the License on the same terms and conditions as the existing License. This ER provides the necessary technical information and data to demonstrate that the Mill's operations continue to be compliant with regulatory standards and that potential environmental impacts and/or radiation exposure to the public and workers are as low as reasonably achievable.

1.3. Benefits of the Proposed Action

The Mill is currently one of only two operating conventional uranium mills in the United States. With the notably high worldwide demand for uranium weighing heavily against limited uranium supplies and domestic processing capabilities, the benefit of the Mill's processing capability is both demonstrable and undeniable. Currently, about 20% of the electric power generated within the United States is derived from nuclear power plants, with a major thrust underway to build additional nuclear power stations both in the United States and abroad. Given that the Mill is centrally located within the Colorado Plateau mining district (a major source of domestic uranium) and that it is one of only two operating uranium mills within the United States (and the only operating uranium mill on the western slope of the Rocky Mountains), the continued operation of the Mill is vital to the uranium mining industry in the region and to the United States nuclear industry as a whole. In addition to this larger energy benefit, the operation of the

Mill provides significant local benefits by supporting the tax base for San Juan County and by providing jobs to local citizens. The Mill is a major employer in San Juan County, which has one of the highest unemployment rates in the state, and depends on the well paying jobs provided by the Mill.

1.4. Applicable Regulatory Requirements, Permits and Required Consultations

1.4.1 Applicable Standards for Review and Approval of the License Renewal Application

R313-22-39 (Executive Secretary Action on Applications to Renew or Amend) provides that in considering an application by a licensee to renew or amend a license, the Executive Secretary of the Utah Radiation Control Board (the "Executive Secretary") will use the criteria set forth in Sections R313-22-33 (General Requirements for the Issuance of Specific Licenses) and R313-24 (Uranium Mills and Source Material Mill Tailings Disposal Facility Requirements) as applicable[1].

In addition, Form DRC-01, 02/94 requires that the application include responses to the "respective item and/or sub item of the licensing guide," which the State of Utah Division of Radiation Control ("DRC") has advised is the applicable U.S. Nuclear Regulatory Commission ("NRC") Standard Review Plan for the type of activity being licensed. For the renewal of uranium mill licenses, Denison has been advised by NRC that the applicable Standard Review Plan is the *Standard Review Plan for In Situ Leach Uranium Extraction License Applications*, NUREG-1569, June 2003 ("NUREG-1569").[2]

Accordingly, the Application must demonstrate that the following criteria enumerated in R313-22-33, as applicable, are satisfied:

a) The applicant and all personnel who will be handling radioactive material are qualified by reason of training and experience to use the material in question for the purpose requested in accordance with the applicable rules in a manner as to minimize danger to public health and safety or the environment;

b) The applicant's proposed equipment, facilities, and procedures are adequate to minimize danger to public health and safety or the environment;

c) The applicant's facilities are permanently located in Utah;

---

[1] R313-22-39 also requires the Executive Secretary to use the applicable criteria in R313-22-50 (Special Requirements for Specific Licenses of Broad Scope), and R313-22-75 (Special Requirements for a Specific License to Manufacture, Assemble, Repair, or Distribute Commodities, Products, or Devices Which Contain Radioactive Material) and in Rules R313-25 (License Requirements for Land Disposal of Radioactive Waste-General Provisions), R313-32 (Medical Use of Radioactive Material), R313-34 (Requirements for Irradiators), R313-36 (Special Requirements for Industrial Radiographic Operations), or R313-38 (Licenses and Radiation Safety Requirements for Well Logging). However, none of these criteria are applicable to uranium mills.

[2] NRC staff advised that they did not prepare a similar Standard Review Plan for uranium mills at that time because they did not anticipate any new uranium mills being constructed, and they concluded that, because both uranium mills and ISL uranium recovery facilities are subject to 10 CFR Part 40, NUREG-1569 could be applied universally to both types of facilities.

d) The issuance of the license will not be inimical to the health and safety of the public;

e) The applicant satisfies applicable special requirements in sections R313-22-50 and R313-22-75, and Rules R313-24, R313-25, R313-32, R313-34, R313-36, or R313-38; and

f) To the extent the original siting of the Mill has resulted in any environmental costs, the Executive Secretary will be able to conclude, after weighing the environmental, economic, technical and other benefits against such environmental costs and considering available alternatives, that the action called for is the issuance of the proposed license renewal.

R313-22-33 provides that a license application shall be approved by the Executive Secretary if the Executive Secretary determines that the forgoing criteria are satisfied.

Similarly, this Application must also demonstrate that the Mill continues to comply with the applicable provisions of 10 CFR Part 40 Appendix A, as required by R313-24-3 and must contain an environmental report describing the proposed action, a statement of its purposes, and the environment affected as required by R313-24-3 and NUREG-1569.

It is important to note that since the Application is for renewal of an existing licensed facility, the Application will focus on any changes to currently licensed activities and on demonstrating how existing licensed facilities continue to meet applicable regulatory criteria. As stated in the introduction to NUREG-1569:

> For renewals, the licensee need only submit information containing changes from the currently accepted license. The licensee need not resubmit a complete application covering all aspects of facility operation. Reviewers should analyze the inspection history and operation of the site to see if any major problems have been identified over the course of the license term and should review changes to operations from those currently found acceptable (see Appendix A). If the changes are found to be acceptable, then the license is acceptable for renewal.
>
> For license amendments and renewals, the operating history of the facility is often a valuable source of information concerning the adequacy of site characterization, the acceptability of radiation protection and monitoring programs, the success of and adherence to operating procedures and training programs, and other data that may influence the staff's determination of compliance. Appendix A to the standard review plan provides guidance for review of these historical aspects of facility performance. [3]

As indicated in the excerpts quoted above and elsewhere in NUREG-1569, Appendix A to NUREG-1569 lists the documentation required and the criteria to be applied in connection with license renewal applications for uranium mills. Appendix A provides that for license renewals, the historical record of site operations, including air and groundwater quality monitoring,

[3] NUREG-1569, page xvii.

provides valuable information for evaluating the licensing actions. The Appendix then lists a number of specific areas where a compliance history or record of site operations and changes should be provided in the application for review. The Appendix then provides that if, after a review of these historical aspects of site operations, the staff concludes that the site has been operated so as to protect health and safety and the environment and that no un-reviewed safety-related concerns have been identified, then only those changes proposed by the license renewal application should be reviewed using the appropriate sections of NUREG-1569. The Appendix concludes by specifically stating that aspects of the facility and its operations that have not changed since the last license renewal should not be re-examined.

1.4.2 Components of the Application

In order to satisfy the requirements of R313-22-39, and applicable criteria set out in R313-22-33, R313-24-3 in accordance with the provisions of NUREG-1569, the Application is comprised of the following:

a) Application Document

The Application document describes the Mill's process and equipment; waste systems; administration, including qualifications of personnel, management controls, inspection and audit programs, training program, radiation protection program, and environmental surveillance program; a review and analysis of potential accidents and the Mill's emergency response programs; the Mill's reclamation plan; and a listing and description of violations, incident investigations, excursions and regulatory exceedances. Attached to or incorporated by reference in the Application are the Mill procedures and programs that are relevant to those matters.

While NUREG-1569 provides that aspects of the facility and its operations that have not changed since the last license renewal should not be re-examined, it is intended that the Application and the documents appended thereto and incorporated by reference therein, together with the accompanying ER, will.

i) demonstrate that Denison and all Mill personnel are qualified by reason of training and experience to perform their respective functions in accordance with applicable rules in a manner as to minimize danger to public health and safety or the environment;

ii) describe the Mill's existing equipment, facilities, and procedures and demonstrate that they continue to be adequate to minimize danger to public health, safety or the environment; and

iii) confirm that the Mill facilities are located in Utah,

as required under R313-22-33, and that the Mill continues to satisfy the applicable special requirements of R313-24.

No changes to the Mill's existing equipment, facilities, and procedures are requested as part of this license renewal process. Some changes to the Mill's equipment, facilities and procedures have been made with the approval of the NRC or in accordance with existing license conditions since the last license renewal in March 1997. These changes are reflected in the descriptions set out in the Application and in the documents incorporated by reference therein. However, since the changes are comprised in the existing License, Executive Secretary approval of these changes is neither sought nor requested by the Application.

b) Environmental Report

This ER accompanies and is incorporated by reference into the Application. This ER incorporates by reference, updates or supplements the information previously submitted in previous environmental analyses performed at the Mill to reflect any significant environmental change, including any significant environmental change resulting from operational experience or a change in operations or proposed decommissioning activities since the last License renewal on March 31, 1997.[4]

A Final Environmental Statement (the "FES") was prepared by NRC for the original Mill License application in May 1979, which is incorporated by reference into, updated or supplemented by this ER. The basis for the FES was the Environmental Report, White Mesa Uranium Project San Juan County, Utah, dated January 1978, prepared by Dames & Moore (the "1978 ER"). In addition, the following environmental evaluations have also been performed for the Mill and are incorporated by reference into, updated or supplemented by this ER:

- an EA was prepared by NRC in September 1985 for the Mill License renewal (the "1985 EA");
- an EA was prepared by NRC in February 1997 for the Mill License renewal (the "1997 EA");
- an EA was prepared for Denison's reclamation plan (the "Reclamation Plan") in February 2000 (the "2000 EA");

[4] Page xvi of NUREG-1569 provides that an applicant for a new operating license, or for the renewal or amendment of an existing license, is required to provide detailed information on the facilities, equipment, and procedures to be used and to submit an environmental report that discusses the effect of proposed operations on public health and safety and the impact on the environment as required by 10 CFR 51.45, 51.60, and 51.66. 10 CFR 51.60 provides that in the case of an application to renew a license issued under 10 CFR Part 40 for which the applicant has previously submitted an environmental report, the applicant may submit a supplement to the applicant's previous environmental report, which may be limited to incorporating by reference, updating or supplementing the information previously submitted to reflect any significant environmental change, including any significant environmental change resulting from operational experience or a change in operations or proposed decommissioning activities. Although the regulations in 10 CFR 51.45, 51.60 and 51.66, which implement Section 102(2) of the National Environmental Policy Act, do not apply to State licensing activities, the State of Utah has its own requirements to prepare an Environmental Report in R313-24-3. It should also be noted that R313-22-32 states that the Application may incorporate by reference information contained in previous applications. By including changes since the last application and incorporating by reference those aspects of previous applications that have not changed, the Executive Secretary will be able to focus his review on those aspects of licensed operations that have changed since the previous license grant.

- an EA was prepared in December, 2001 (the "2001 EA") in connection with a license amendment issued by NRC authorizing the receipt and processing at the Mill of certain alternate feed materials from Molycorp Inc.'s Mountain Pass Facility;

- an EA was prepared in August, 2002 (the "2002 EA") in connection with a license amendment issued by NRC authorizing receipt and processing at the Mill of certain alternate feed materials from the Maywood Formerly Utilized Sites Remedial Action Program ("FUSRAP") site in Maywood, New Jersey;

- a Statement of Basis was prepared in December 2004 by DRC in connection with the issuance of the Mill's Groundwater Discharge Permit (the "GWDP Statement of Basis"); and

- a Safety Evaluation Report was prepared by DRC in November 2005 in connection with a license amendment issued by the Executive Secretary authorizing receipt and processing at the Mill of certain alternate feed materials from the FMRI facility in Muskogee Oklahoma (the "FMRI SER").

Accordingly, this ER includes the following matters as contemplated by Appendix A to NUREG-1569:

i) Updates and changes to any site characterization information important to the evaluation of exposure pathways and doses including site location and layout; uses of adjacent lands and waters; population distributions; meteorology; the geologic or hydrologic setting; ecology; background radiological or non-radiological characteristics; and other environmental features;

ii) Environmental effects of site operations including data on radiological and non-radiological effects, accidents, and the economic and social effects of operations;

iii) Updates and changes to factors that may cause reconsideration of alternatives to the proposed action;

iv) Updates and changes to the economic costs and benefits for the facility since the last application; and

v) The results and effectiveness of any mitigation proposed and implemented in the original license.

With respect to the assessment of any impact on groundwater resulting from the activities conducted pursuant to the License, this ER incorporates by reference certain reports, or portions thereof, filed with the Co-Executive Secretary of the Utah Water Quality Board pursuant to the Mill's Groundwater Discharge Permit ("GWDP")(see Section 1.4.3.2 below).

The result of the foregoing is that, as required by R313-24-3, this ER, together with the previous environmental analyses and reports incorporated by reference herein, or updated or supplemented by this ER, describes the proposed action, a statement of its purposes, and the environment affected, and presents a discussion of the following:

- An assessment of the radiological and non-radiological impacts to the public health from the continuation of the activities to be conducted pursuant to the License;

- An assessment of any impact on waterways and groundwater resulting from the continuation of the activities conducted pursuant to the License;

- Consideration of alternatives, including alternative sites and engineering methods, to the continuation of the activities to be conducted pursuant to the License; and

- Consideration of the long-term impacts including decommissioning, decontamination, and reclamation impacts, associated with the continuation of the activities to be conducted pursuant to the License.

Table 1-1 was prepared as a means of identifying the location in the ER of each of the subjects listed above.

Table 1-1
Location of Components in the Environmental Report

ER Report Subject	Location In Environmental Report
Site Location and Layout	Section 3.1
Use of adjacent Lands & Water	Sections 3.10 & 3.7.3.2
Population Distribution	Section 3.9
Meteorology	Section 3.3
Geologic Setting	Sections 3.4 & 3.7.2.1
Hydrologic Setting	Sections 3.7.2.2, 3.7.2.3 & 3.7.2.4
Ecology	Section 3.12
Background Radiological & Non-Radiological Characteristics	Sections 3.3.2, 3.3.2.3, 3.7.1.2, 3.7.3, 3.7.4, & 3.13.1
Environmental effects of site operations	Sections 3.3.2.3, 3.7.1.3, 3.7.3, 3.7.4 & 3.13
Accidents	Section 4
Economic and Social Effects	Sections 3.9.2 & 5
Updates and Changes to factors that that may cause reconsideration of alternatives	Section 2
Cost and Benefit Analysis	Section 5
Mitigation of Impacts	Section 7

1.4.3 Applicable Regulatory Standards for Mill Operations

The Mill is subject to numerous regulatory standards, many of which are addressed in various sections of this ER. The main regulatory standards are the following:

i) Utah Regulations Applicable Specifically to Uranium Mills

The Mill must comply with the applicable provisions of 10 CFR Part 40 Appendix A, as required by R313-24-3.

ii) Utah Radiation Protection Standards

The primary radiation protection standards applicable to the Mill are found in R313-15.

iii) Utah Groundwater Protection Regulations

The Mill must comply with the Utah Water Quality Act (Utah Code Annotated 19-5) and the Utah Ground Water Quality Protection Regulations (Utah Administrative Code R317-6).

iv) Clean Air Act

The Mill must also comply with Clean Air Act national emission standards for hazardous air pollutants ("NESHAPs"). The requirements for operating (i.e., active) uranium mills are set forth in 40 CFR Part 61, Subpart W.

1.4.4 Licenses and Permits

The Mill has the following License and permits in place which provide the regulatory framework for Mill Operations and the environmental, health & safety procedures.

i) Mill Radioactive Materials License

As mentioned above, the Mill holds the License, which was issued pursuant to the provisions of R313-22 and R313-24.

ii) Groundwater Discharge Permit

The State groundwater protection rules described in Section 1.4.2.5 above are implemented at the Mill through State of Utah Groundwater Discharge Permit No. UGW370004.

iii) State of Utah Air Quality Permit

The State of Utah Department of Environmental Quality ("UDEQ") administers and implements the State's rules and regulations for air quality.

Denison holds Division of Air Quality Approval Order No. DAQE-AN 1205005-06 (the "Air Quality Permit"), issued by UDEQ, for the Mill. The Air Quality Permit describes the approved air pollution control equipment required to be operated at the Mill, and sets limitations and test procedures for emissions to the atmosphere from the indicated emission points, as well as general procedures for controlling dust from roads and fugitive sources.

1.4.5 Consultations

No consultations of other agencies were made by Denison in connection with this Application. This is because the Mill is an existing licensed facility that is operating in accordance with its License and in compliance with applicable regulatory standards, and Denison seeks a renewal of its License to continue its existing operations on the same terms and conditions. However, the Executive Secretary may make any such consultations he deems appropriate.

1.5 Alternate Feed Program

Under the License, the Mill is authorized to process conventionally mined ores and certain alternate feed materials. Alternate feed materials are acceptable for processing at the Mill if they meet the criteria set out in NRC's Alternate Feed Guideline and a specific License amendment authorizing receipt and processing of the Alternate Feed Material at the Mill is issued by the Executive Secretary. In reviewing a proposed Alternate Feed Material, the Mill and the Executive Secretary must determine on a case-by-case basis whether the proposed feed material can be processed at the Mill in a manner that does not give rise to any significant public health, safety or environmental impacts, over and above the previously licensed activities. The Mill intends to continue to pursue its alternate feed program set out in Section 3.13.2 of this ER.

2. ALTERNATIVES

2.1 Consideration of Alternatives

The action under consideration is the renewal of the License for continued operation of the Mill. The alternatives available to the Executive Secretary are to:

a) Renew the License with its existing terms and conditions;

b) Renew the License with such additional conditions as are considered necessary or appropriate to protect public health, safety and the environment; or

c) Deny renewal of the License.

As demonstrated in this ER, the environmental impacts associated with renewal of the License do not warrant either limiting the Mill's future operations or denying the License renewal. As there are no significant public health, safety or environmental impacts associated with renewal of the License on its existing terms and conditions, Denison asserts that alternatives with equal or greater impacts need not be evaluated, and alternative a) is the appropriate alternative for selection.

2.1.1 Renewal of the License

The Mill is one of only two operating uranium mills in the Unites States and the only uranium mill on the western slope of the Rocky Mountains. As a result, the Mill is the only currently available opportunity for production of uranium from conventionally mined ore in San Juan County and in the four corners area of the United States. The Mill therefore provides a benefit to the regional community and to the uranium industry as a whole in the United States. Renewal of the License would allow the Mill to continue to provide these benefits.

As will be demonstrated in Section 3 of this ER, the Mill's equipment, facilities and procedures are adequate to minimize impacts to public health, safety and the environment. The Mill has operated since its inception in compliance with all applicable regulatory standards and ALARA goals and is capable of continuing to operate in compliance with such standards and goals.

In addition to the License, the Mill has been issued a Groundwater Discharge Permit, which provides additional protection for public health and the environment. The Mill has demonstrated that it is capable of continuing to operate in a manner that satisfies all regulatory standards and ALARA goals under the existing terms and conditions of the License and GWDP, there is no need to add any additional conditions to the License in order to protect public health, safety or the environment.

2.1.2 No Action Alternative

A "no action" alternative would result in the License renewal application being denied and the immediately available processing opportunities for mined uranium ore being lost in the short term, severely impacting independent uranium miners in the area and lessening the United States' capability to respond to the need for uranium for nuclear power generation.

Denying renewal of the License would eliminate utilization of the Mill during a time when commodity prices for uranium are favorable, and the demand for uranium milling capacity is unprecedented. Permitting the Mill to continue processing conventionally mined ore for the recovery of uranium will provide the opportunity for regular employment in an economically depressed area of the United States. A large percentage of the workers at the Mill are Native American, and this employment opportunity has significant direct impact in the local Native American community. In addition to the direct hiring of employees at the Mill, local miners and other western United States mining companies require access to an operating uranium mill. The inability of these mining entities to gain access to local milling services will prevent the mining industry from responding to the current uranium supply shortage. Thus, secondary local economies will not enjoy the benefit of renewed mining income, and national demand for uranium will continue to be reliant primarily on foreign supplies of uranium for nuclear fuel. In order to respond to the current uranium market, conventional mining companies will be forced to license and construct new uranium milling facilities to engage in conventional ore processing, directly in opposition to the objective of non-proliferation of new uranium mill tailings disposal facilities embodied by 10 CFR Part 40 Appendix A, Criterion 2.

As will be demonstrated in Section 3 of this ER, the impacts associated with renewal of the License and continued operations thereunder will be within the realm of impacts anticipated in the FES, the 1985 EA and the 1997 EA, and the continued licensing of the Mill will satisfy applicable criteria in R313-22-33 and R313-24. As a result, Denison asserts that the Executive Secretary should have no basis for denying the proposed action.

2.1.3 Alternatives Considered But Eliminated

i. Consideration of Alternative Sites

The Mill is already sited and in existence and has been operating for over 25 years. It is not feasible to consider moving the Mill to an alternative site. Even if that were possible, as will be demonstrated in Section 3 of this ER, the Mill is sited in a good hydrogeologic setting and is otherwise well sited for its operations. This is evident from the fact that the Mill has operated since its inception in compliance with applicable regulatory standards and ALARA goals.

If the License is not renewed, there can be no assurance that, as an alternative, an equally well-suited site, that complies with the applicable siting requirements of 10 CFR Part 40 Appendix A, can be identified and obtained. Even if a suitable alternative site were to be identified and obtained, licensing and construction of a new mill could not be accomplished in a time frame that would ensure production could commence in a period of suitable market conditions. Furthermore, as the existing Mill tailings would have to be decommissioned in place, creation of a new mill site would result in unnecessary proliferation of mill tailings disposal facilities in contravention of 10 CFR Part 40 Appendix A, Criterion 2.

2.1.4 Consideration of Alternative Engineering Methods

As will be demonstrated in Section 3, the existing Mill facilities, equipment, procedures and training of personnel have resulted in the Mill operating since inception in compliance with all applicable regulatory standards and ALARA goals. Current modeling demonstrates that the Mill is capable of continuing to operate under the existing terms and conditions of the License in a manner that will continue to comply with such standards and goals. Furthermore, the Mill's GWDP institutes additional protections and engineering controls, including the requirement that any new construction of tailings cells must meet current best available technology standards. Therefore, there is no need to consider alternative engineering methods. The existing equipment and facilities, together with the existing terms and conditions of the License and the GWDP are sufficient to ensure that all applicable requirements will continue to be satisfied.

2.2 Cumulative Effects

There are no past, present, or reasonably foreseeable future actions which could result in cumulative impacts that have not been contemplated and previously approved under the existing Mill License.

As stated throughout this ER, License renewal will result in no activity with potential, significant, incremental impacts to public health, safety or the environment over and above the actions contemplated in the FES, the 1985 EA and the 1997 EA. The activities contemplated with regard to ore processing remain unchanged from those previously authorized under the License.

2.3 Comparison of the Predicted Environmental Impacts

There have been no observed significant impacts which were not previously quantified and addressed to public health, safety or the environment resulting from existing activities conducted under the License. As there will be no significant changes in Mill operations if the License is renewed under its existing terms and conditions, possible impacts to public health, safety or the environment will not exceed those predicted in the original License application and periodic renewals.

2.4 Updates & Changes to Factors That May Cause Reconsideration of Alternatives

As discussed in Section 5, Costs and Benefits, there have been no changes to factors that may cause reconsideration of alternatives. There have been no significant changes in the costs associated with operation of the Mill, and the benefits associated with continued operation of the Mill have become more evident over time as the number of uranium mills has dwindled and the demand for uranium milling services from local miners and the industry as a whole has increased in recent years. Furthermore, no new alternatives to the services provided by the Mill have been identified since the last License renewal in 1997.

3. DESCRIPTION AND ASSESSMENT OF THE AFFECTED ENVIRONMENT

3.1 Introduction

This Chapter of the ER provides a description and an assessment of the environment surrounding the already licensed and existing White Mesa Uranium Mill ("the Mill"). The environmental and radiation monitoring results to date demonstrate that the Mill has been operating in compliance with applicable regulatory standards and ALARA goals, and that continued operation of the Mill can be accomplished in accordance with such standards and goals.

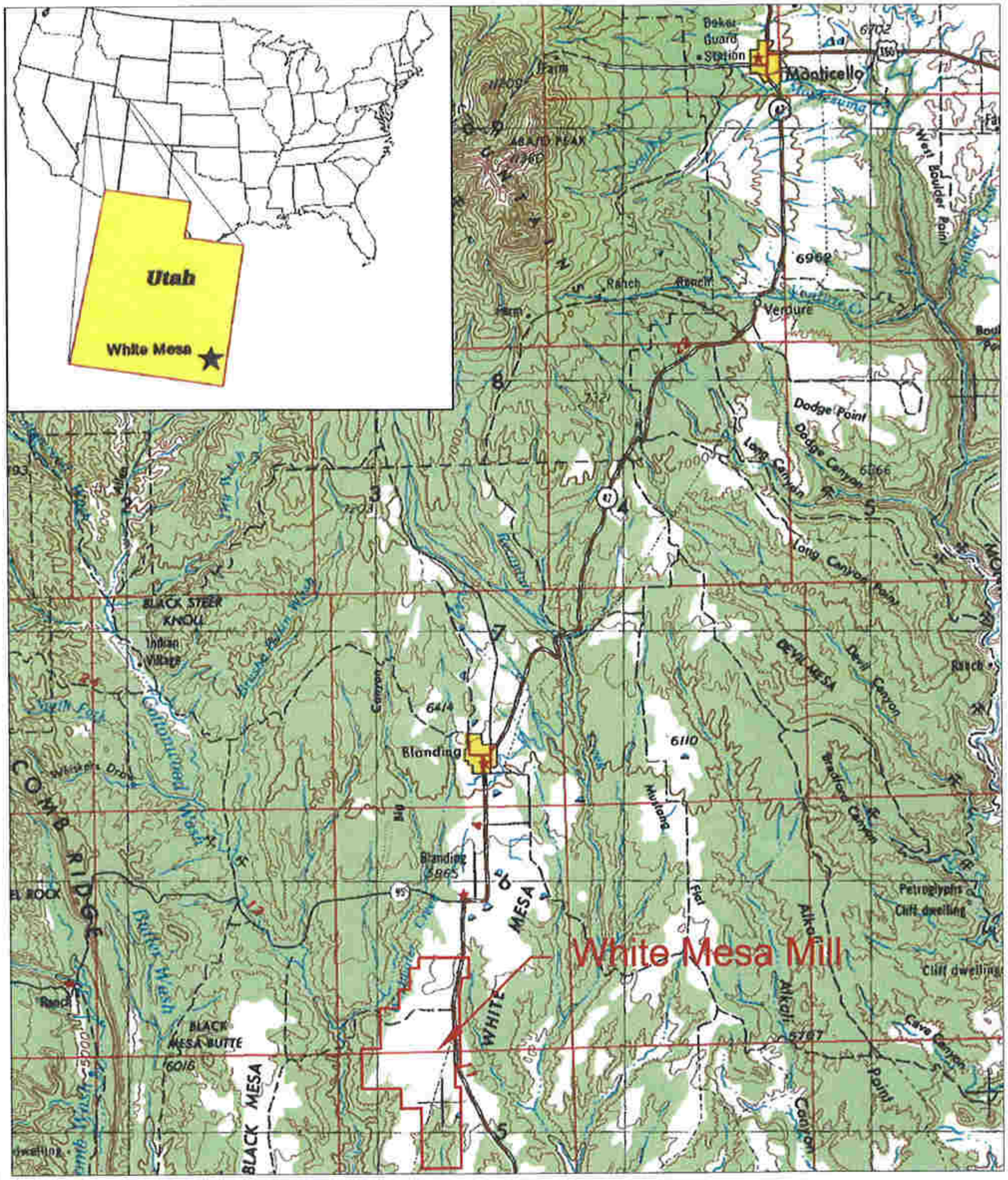
3.2 Site and/or Facility Description and Location

The Mill is regionally located in central San Juan County, Utah, approximately 6 miles (9.5 km) south of the city of Blanding. The Mill can be reached by taking a private road for approximately 0.5 miles west of Utah State Highway 191. See Figure 3.2-1.

Within San Juan County, the Mill is located on fee land and mill site claims, covering approximately 5,415 acres , encompassing all or part of Sections 21, 22, 27, 28, 29, 32, and 33 of T37S, R22E, and Sections 4, 5, 6, 8, 9, and 16 of T38S, R22E, Salt Lake Base and Meridian. See Figure 3.2-2.

All operations authorized by the License are conducted within the confines of the existing site boundary. The milling facility currently occupies approximately 50 acres and the tailings disposal cells encompass another 250 acres. See Figure 3.2-2.

The resident currently nearest to the milling facility is located approximately 1.2 miles (1.9 km) to the north of the Mill site, just north of air sampling station BHV-1. See Figure 3.3-2.



Denison Mines (USA) Corp.			
Project	WHITE MESA MILL		
REVISIONS	County:	State: UT	
Date / By	Location:		
	Figure 3.2-1 White Mesa Mill Location Map		
	Scale: as shown	Date: Feb. 2007	figure 3.2-1.dwg
	Author: bm	Drafted By: B. Munkhbaatar	

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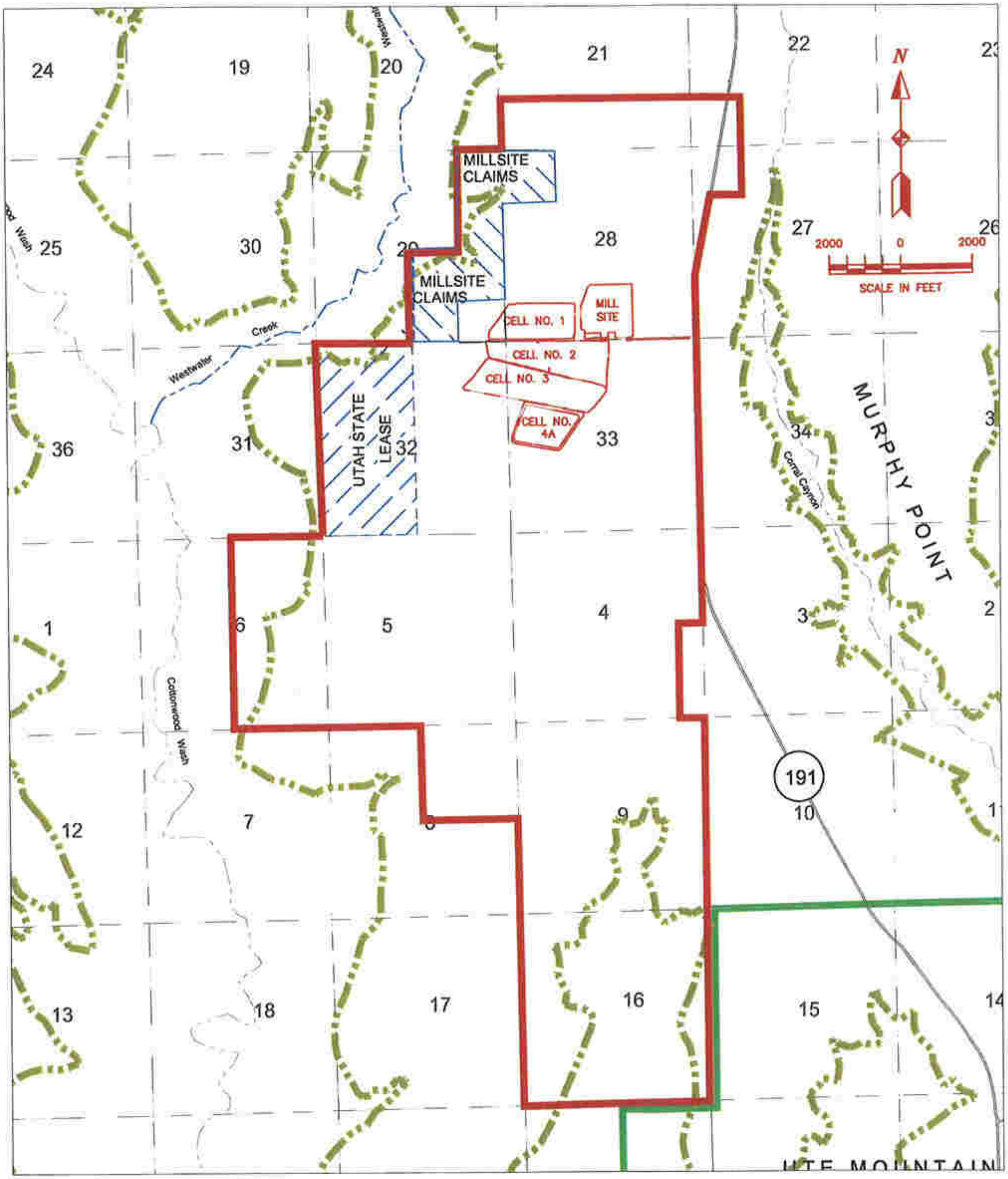

	Property Boundary
	Reservation Boundary
	Canyon Rim

Denison Mines (USA) Corp.

Project: WHITE MESA MILL

REVISIONS

Date	By

County: State: UT

Location:

Figure 3.2-2
White Mesa Mill
Land Map

Scale: as shown | Date: Feb. 2007 | figure 3.2-2.dwg

Author: bm | Drafted By: B. Munkhbaatar

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3.3 Climate, Meteorology and Non-Radiological Air Quality

3.3.1 Climate and Meteorology

3.3.1.1 Regional

The climate of southeastern Utah is classified as dry to arid continental. Although varying somewhat with elevation and terrain, the climate in the vicinity of the Mill can be considered as semi-arid with normal annual precipitation of about 13.4 inches. Most precipitation is in the form of rain with snowfall accounting for about 29% of the annual total precipitation. There are two separate rainfall seasons in the region, the first in late summer and early autumn (August to October) and the second during the winter months (December to March). The mean annual relative humidity is about 44 percent and is normally highest in January and lowest in July. The average annual Class A pan evaporation rate is 68 inches (National Oceanic and Atmospheric Administration and U.S. Department of Commerce, 1977), with the largest evaporation rate typically occurring in July. This evaporation rate is not appropriate for determining water balance requirements for the tailings management system and must be reduced by the Class A pan coefficient to determine the later evaporation rate. Values of pan coefficients range from 60% to 81%. Denison assumes for a water balance calculations an average value of 70% to obtain an annual lake evaporation rate for the Mill area of 47.6 inches. Given the annual average precipitation rate of 13.4 inches, the net evaporation rate is 34.2 inches per year.

The weather in the Blanding area is typified by warm summers and cold winters. The mean annual temperature in Blanding is about 50°F. January is usually the coldest month and July is usually the warmest month.

Winds are usually light to moderate in the area during all seasons, although occasional stronger winds may occur in the late winter and spring. The predominant winds are from the north through north-east (approximately 30 percent of the time) and from the south through south-west (about 25 percent of the time). Winds are generally less than 15 mph, with wind speeds faster than 25 mph occurring less than one percent of the time. The National Weather Service Station in Blanding, Utah is located about 6.25 miles north of the Mill. Data from the station is considered representative of the local weather conditions (1978 ER, Section 2.7.2). However, as an element of the pre-construction baseline study and ongoing monitoring programs, the Mill operates an onsite meteorological station, described in greater detail below. Further details about weather and climate conditions are provided in the 1978 ER (Section 2.7) and in the FES (Section 2.1).

3.3.1.2 On Site

On-site meteorological monitoring at the Mill was initiated in early 1977 and continues today. The original purpose of the meteorological monitoring program was to document the regional atmospheric baseline and to provide data to assist in assessing potential air quality and radiological impacts arising from operation of the Mill.

After the Mill construction was completed, the monitoring programs were modified to facilitate the assessment of Mill operations. The current meteorological monitoring program includes data collection for wind speed, wind direction, atmospheric stability according to the standard Pasquill scheme (via measurements of deviations in wind direction, referred to as sigma-theta), and precipitation as either rain or snow. The recorded on-site meteorological conditions are reported to Denison on a semi-annual basis and are described in semi-annual reports prepared for Denison and maintained at the Mill. Figure 3.3-1 shows the windrose for the Mill site for the period of January – December 2006, the most recent full year of compiled meteorological data.

3.3.2 Baseline Air Quality

3.3.2.1 FES Evaluation

At the time of the 1978 ER and FES, the Four Corners Air Quality Control Region which encompasses parts of Colorado, Arizona, New Mexico and Utah and within which the Mill site is located had a priority IA rating, signifying a violation of federal air standards. The rating was for particulate matter and sulfur dioxide due to emissions from fossil-fueled power plants located within the region (1978 ER, Sect. 2.7.4.2). This was an important consideration at the time since the original proposal was to use coal and oil as the source of process and building heat at the Mill. Thus, much of the discussion of potential air quality effects of the Mill arose from consideration of the potential effects of wind-blown dust from coal storage stockpiles and from air emissions of sulfur dioxides, particulate matter, carbon monoxide, and nitrogen oxides arising from the combustion of coal at the Mill. However these concerns are moot since the last time coal was used to fire boilers at the Mill was 1990. By the time the Mill commenced the 1994/1995 mill run, propane was chosen to fire all process and heating boilers, and this remains the fuel of choice as the operation continues.

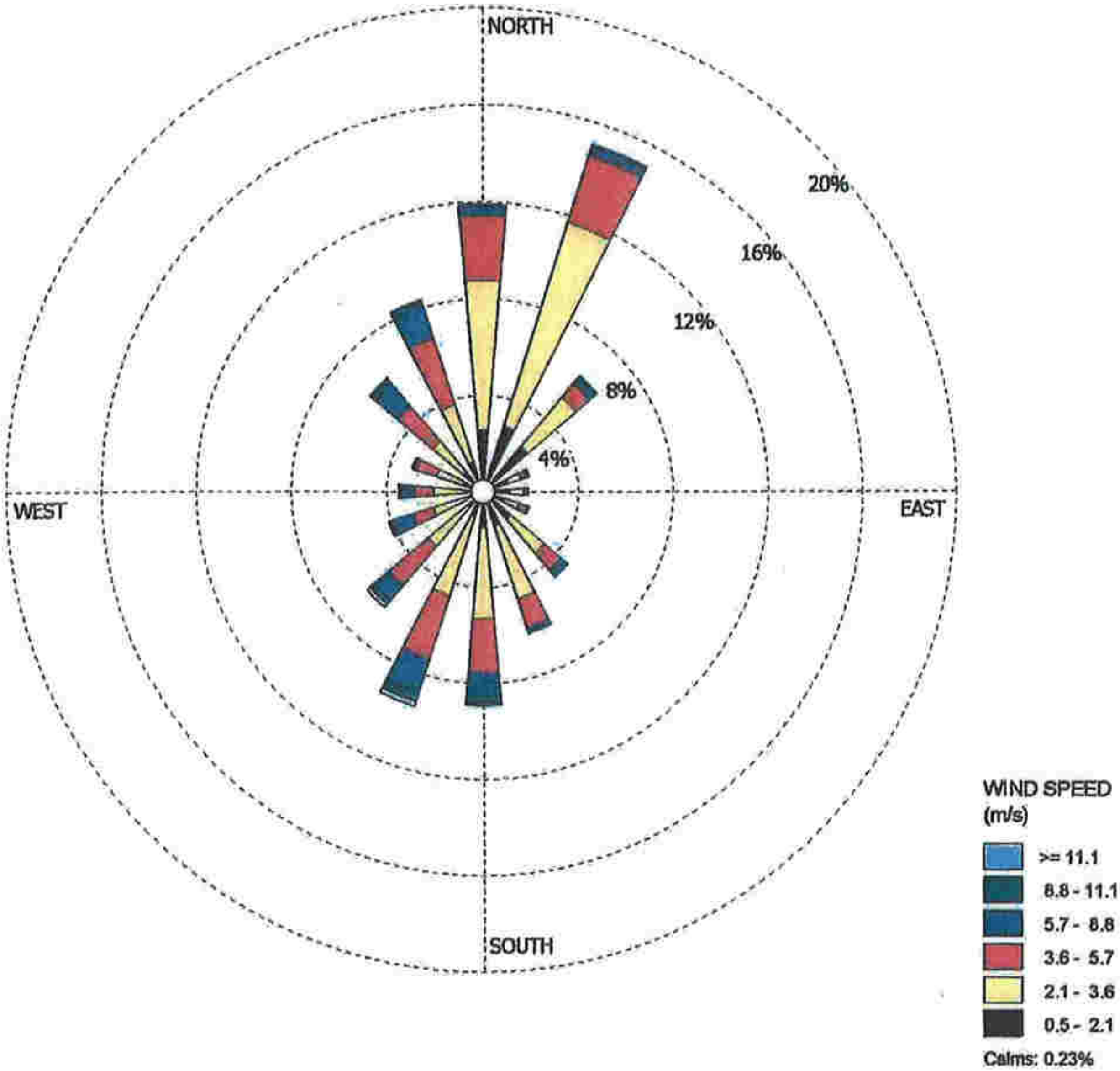
The FES, based on data collected for one year prior to construction of the Mill at four sampling locations, reported various background air quality data for the project site and compared them to then existing criteria. The FES reported dustfall to average 33 g/m^2 per month with the highest monthly average of 102 g/m^2 occurring in August. The FES also reported a geometric mean total suspended particulate (TSP) level of 18 μg/m^3, based on monitoring from October 1977 through February 1978 (See FES Section 2.2). This value is well below the Federal and State air quality standard.

3.3.2.2 Effects on Air Quality Projected for Mill Operations

The FES (Section 4.1.2) concluded that, while air quality during operation of the Mill could be affected by atmospheric releases (principally from the building and processing boilers, yellowcake and vanadium dryers, tailings disposal system, and ore stockpiles), the operation of the Mill facility should not have any significant impact on air quality. See Section 3.3.2.3 below.

White Mesa Mill
Blanding, Utah

Wind Speed
Direction (blowing from)



DATA PERIOD: 2006 Jan 1 - Dec 31 00:00 - 23:00	COMPANY NAME: Denison Mines		
	MODELER: McVehil-Monnett Associates	FIGURE 3.3-1	
CALM WINDS: 0.23%	TOTAL COUNT: 8149 hrs.		
AVG. WIND SPEED: 3.53 m/s		PROJECT NO.: 2018-06	

WRPLOT View - Lakes Environmental Software

3.3.2.3 Operational Environmental Air Monitoring Data (non-radiological)

This Section discusses only the non-radiological air monitoring programs, whereas the radiological air monitoring programs are discussed in Section 3.13.1.7. In this regard, the non-radiological air emissions from the Mill are regulated by the State of Utah in accordance with the Mill's Air Quality Permit (Approval Order No. DAQE-AN1205005-06). Amongst other features, the Air Quality Permit sets out annual emissions limits for the yellowcake dryers and the vanadium circuit scrubber. The Air Quality Permit also describes emissions controls for sources in the Mill and general procedures for controlling dust from roads and fugitive sources. Also, the Permit specifies that the Mill must comply with various Federal requirements including those of 40 CFR Part 61 concerning emissions of radon from the Mill tailings.

Specifically, the Air Quality Permit requires that particulate (PM-10) emissions to the atmosphere shall not exceed 0.40 lbs per hour for each yellowcake dryer and 2.50 lbs per hour for the vanadium circuit scrubber. The Air Quality Permit requires that initial compliance testing of the scrubber and dryers must be performed within 180 days of the start up of a new emission point or the inclusion of an emission point in the Permit, and thereafter, if and when directed by the Utah Department of Environmental Quality (UDEQ). The yellowcake dryers were initially tested under the Air Quality Permit when the second yellowcake dryer was installed in connection with the 1995/1996 mill run and again in June, 2006 in connection with restart of yellowcake drying operations. The yellowcake dryers were not operated for sufficient duration during the intervening years to prompt testing. The June, 2006 testing showed that the yellowcake dryer was operating within this compliance limit.

With regard to the vanadium circuit scrubber, the 1995/1996 mill run, as well as the subsequent alternate feed processing campaigns, did not involve vanadium production, and the vanadium circuit was not operated. For the 1999 Mill run, while some vanadium was produced, product finishing (where the vanadium scrubber is employed) was not of a sufficient duration to prompt the compliance testing program. However, vanadium production is anticipated early in this licensing cycle, and vanadium circuit scrubber emissions will be tested at that time.

In order to ensure compliance with applicable air quality standards and the requirements of the Air Quality Permit, the Permit recognizes the specifications of emission generating equipment and emission control equipment at the Mill, and places restrictions on the use of such equipment as an emission control mechanism. For example, the Permit provides that no more than 720,720 tons of ore may be processed in any 12 month period and that the total amount of propane gas consumption for the boiler facilities shall not exceed 2,960,880 gallons per 12 month period, in each case without the prior approval of UDEQ. In this way, the Permit ensures compliance with applicable standards by:

- Recognizing the nature of the Mill's operations and emission control systems

- Controlling the throughput rate and propane consumption to maintain compliance with the emission standards, and

- Placing other restrictions on air emission-generating activities at the Mill in a manner that is calculated in the Permit, ensuring compliance with applicable air quality standards.

In addition to the operational controls established by the Air Quality Permit, the Mill is required to submit to UDEQ an Annual Air Emission Inventory. Table 3.3-1 sets out the Annual Air Emission Inventory for the key criteria emissions for the last eight years. The key criteria emissions are: PM-10 (particulate measuring 10 microns or less); sulfur oxides (SOX); nitrogen oxides (NOX); volatile organic compounds (VOC); and carbon monoxide (CO).

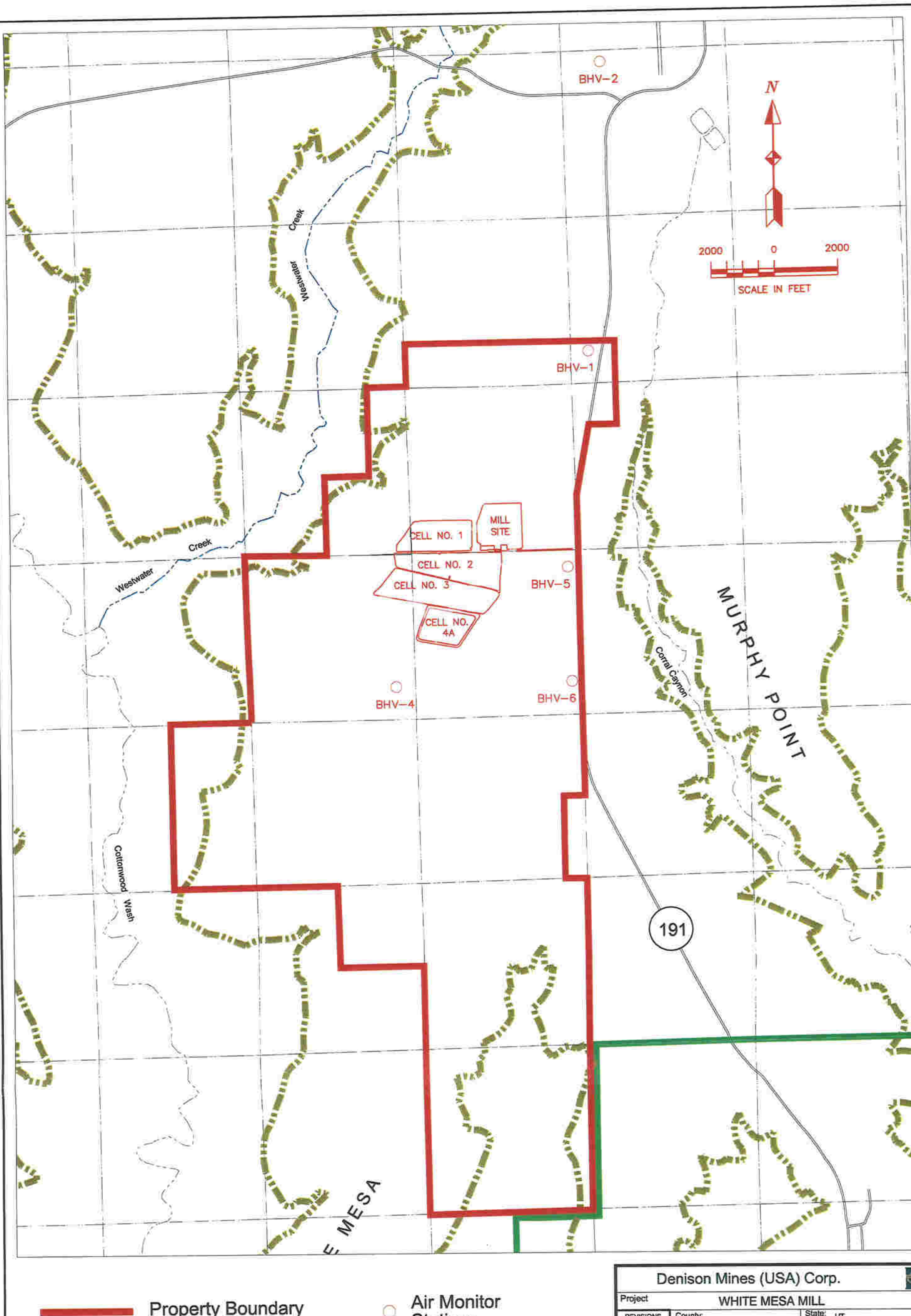
Table 3.3-1
Air Emission Inventory for Key Criteria Emissions (tons/yr)

Year	PM-10	SOX	NOX	VOC	CO
1997	0.775	0.255	3.859	2.120	7.257
1998[1]	-	-	-	-	-
1999	2.57	1.15	18.11	2.16	14.14
2000	1.9	1.47	14.61	2.76	11.78
2001[1]	-	-	-	-	-
2002	0.68	0.98	9.04	1.80	11.49
2003[1]	-	-	-	-	-
2004[1]	-	-	-	-	-
2005	0.18	0.20	2.17	0.31	3.69
2006[1]	-	-	-	-	-

[1]Not required to file an Air Emission Inventory for the year because it was determined that the Mill did not realize a change of 5% or more in emissions for any criteria pollutant reported in the previous year.

In addition, and as part of the Mill's License-driven environmental air monitoring program for radionuclides (See Section 3.13.1.7), non-radiological total particulate matter is collected and measured at the facility's environmental air monitoring stations. The environmental air monitoring program utilizes four high volume continuous air sampling stations, which have been placed at the locations indicated in Figure 3.3-2 (Stations BHV-1, BHV-2, BHV-4, BHV-5). In addition, in 1999 a fifth sampler (BHV-6) was located south of the facility and between the Mill and the White Mesa Ute community. The filters collected from these samplers are weighed for total particulate loading and analyzed for principal radionuclide parameters. The data derived from this monitoring effort are reported in the Semi-Annual Effluent Monitoring Reports that are filed with the Executive Secretary, examples of which are provided with the Application. A more detailed discussion of the environmental air monitoring regimen and airborne radionuclide particulate measurement program is provided at Section 3.13.1.7.1 below.

Z:\White Mesa Mill\2007 License Renewal Application\Environmental Report - Figures\figure 3.3-2.dwg, Figure 3.3-2, 02/24/2007 4:17:29 PM, Adobe PDF.pc3, 11 x 17



Property Boundary

Reservation Boundary

Canyon Rim

Air Monitor Stations

Denison Mines (USA) Corp.		
Project	WHITE MESA MILL	
REVISIONS	County:	State: UT
Date / By	Location:	
	Figure 3.3-2 High Volume Air Monitoring Stations	
Scale: as shown	Date: Feb. 2007	figure 3.3-2.dwg
Author: HRR	Drafted By: B.Munkhbaatar	

During the 1999 natural uranium ore mill run, from April through October, 1999 (including the period of highest winds), the average total particulate suspended matter collected from all environmental sample locations was 20 $\mu g/m^3$. This value appears to be within the measurement error of the local background concentration of (18 $\mu g/m^3$) reported in the original FES Evaluation. The maximum value from any location for seven consecutive days was 40 $\mu g/m^3$.

With regard to temporal maximum site information, during a period of April-October, 2001, when San Juan County was also experiencing a local drought and including the annual windy period, Denison's site-wide average total suspended particulate measurement was only 26 $\mu g/m^3$. More importantly, the maximum individual measurement was 44 $\mu g/m^3$, well below the regulatory limitation and principally due to general dusting, absent any influence by the Mill. In addition, because this climatic environment would represent the local "worst case" for dusting, it would be highly unlikely that the Mill's influence would ever exceed the total suspended particulate standard.

By means of these comparisons, it can be concluded that total suspended particulate measurements during Mill operations have been observed to be similar to those experienced under natural local conditions and that particulate impact from the Mill is low.

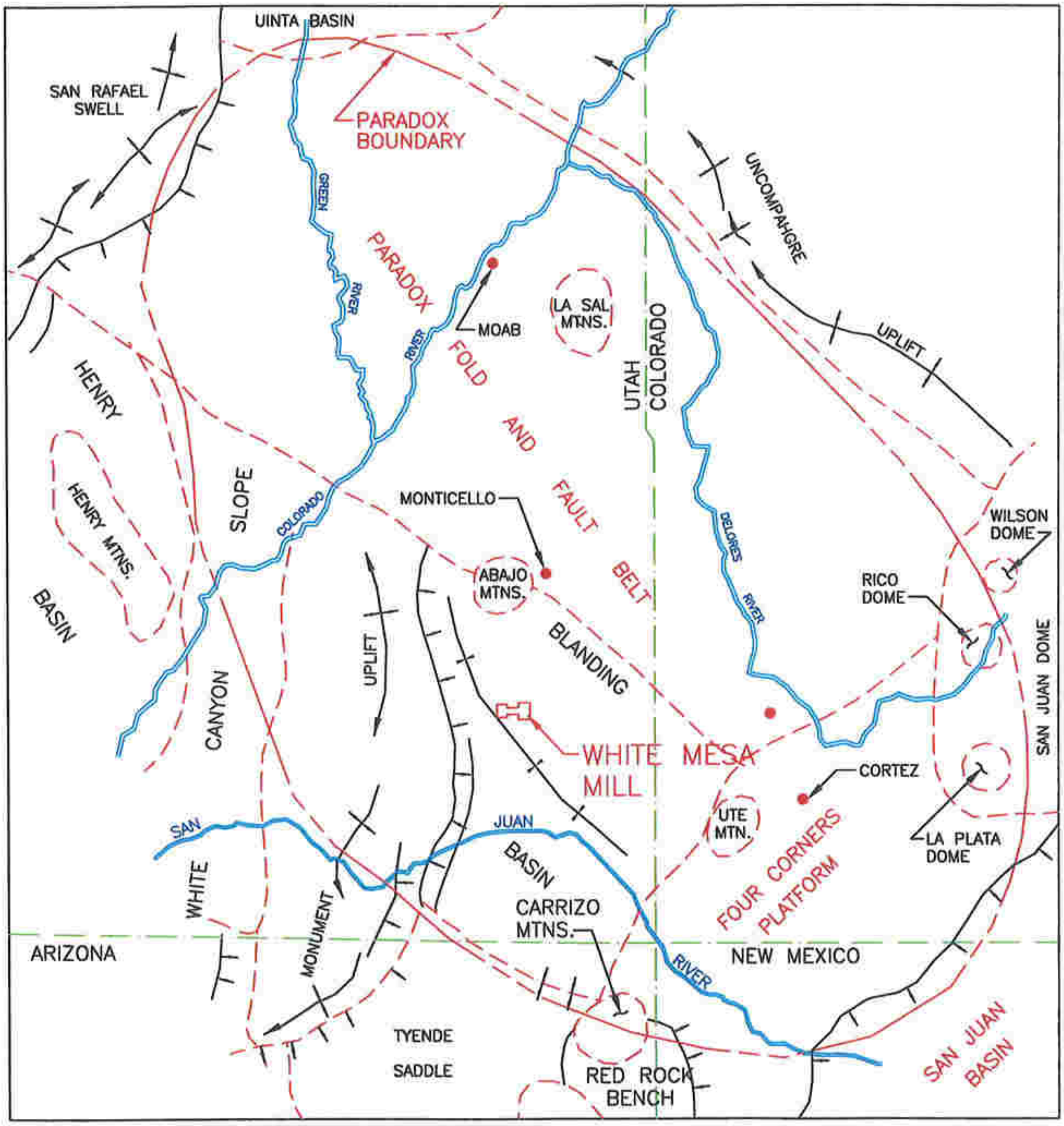
3.4 Geology

3.4.1 Regional Geology

The Mill site lies within a region designated as the Canyon Lands section of the Colorado Plateau physiographic province (Figure 3.4-1). Elevations in the region range from approximately 3,000 feet in the bottom of canyons to over 11,000 feet among the peaks of the Henry, Abajo and La Sal Mountains. The average elevation for the area, excluding deeper canyons and isolated mountain peaks, is about 5,000 feet.

The sedimentary rocks exposed in southeastern Utah have a total thickness of approximately 6,000 to 7,000 feet. These sedimentary units range in age from Pennsylvanian to Late Cretaceous; older rock units which underlie those of Pennsylvanian age are not exposed in the Mill site area.

Structural features in the Mill site area have been divided into three main categories on the basis of origin or mechanism of the stress that created the structure. These categories are: (1) structures related to large-scale regional uplifting or downwarping directly related to movements in the basement complex (the Monument Uplift and the Blanding Basin); (2) structures due to diapiric deformation of thick sequences of evaporate deposits, salt plugs and salt anticlines (the Paradox Fold and Fault Belt); and (3) structures formed due to magmatic intrusions (the Abajo Mountains).



LEGEND

BOUNDARY OF TECTONIC DIVISION

MONOCLINE SHOWING TRACE OF AXIS AND DIRECTION OF DIP

ANTICLINE SHOWING TRACE OF AXIS AND DIRECTION OF PLUNGE

SYNCLINE SHOWING TRACE OF AXIS AND DIRECTION OF PLUNGE

Denison Mines (USA) Corp.			
Project	WHITE MESA MILL		
REVISIONS	County:	State: UT	
Date / By	Location:		
	Figure 3.4-1		
	Colorad Plateau Geologic Map		
	Scale: N/A	Date: Feb. 2007	figure 3.4-1.dwg
	Author: HRR	Drafted By: B.Munkhbaatar	

A generalized stratigraphic column for the region is provided as Figure 3.4-2. The Summerville Formation, Entrada Sandstone, and Navajo Sandstone are the deepest units of concern encountered at the site.

3.4.2 Local Geology

The Mill site is located on the western edge of the Blanding Basin, sometimes referred to as the Great Sage Plain, lying east of the north/south-trending Monument Uplift, south of the Abajo Mountains and adjacent to the northwest-trending Paradox Fold and Fault Belt. The Abajo Mountains are the most prominent topographic feature in the region, rising over 4,000 ft above the surface of the plain. The lithology of the immediate area is composed of thousands of feet of multi-colored pre-Tertiary age marine and non-marine sedimentary rocks. Erosion on the regionally-uplifted sedimentary strata has produced an array of eroded canyons and mesas.

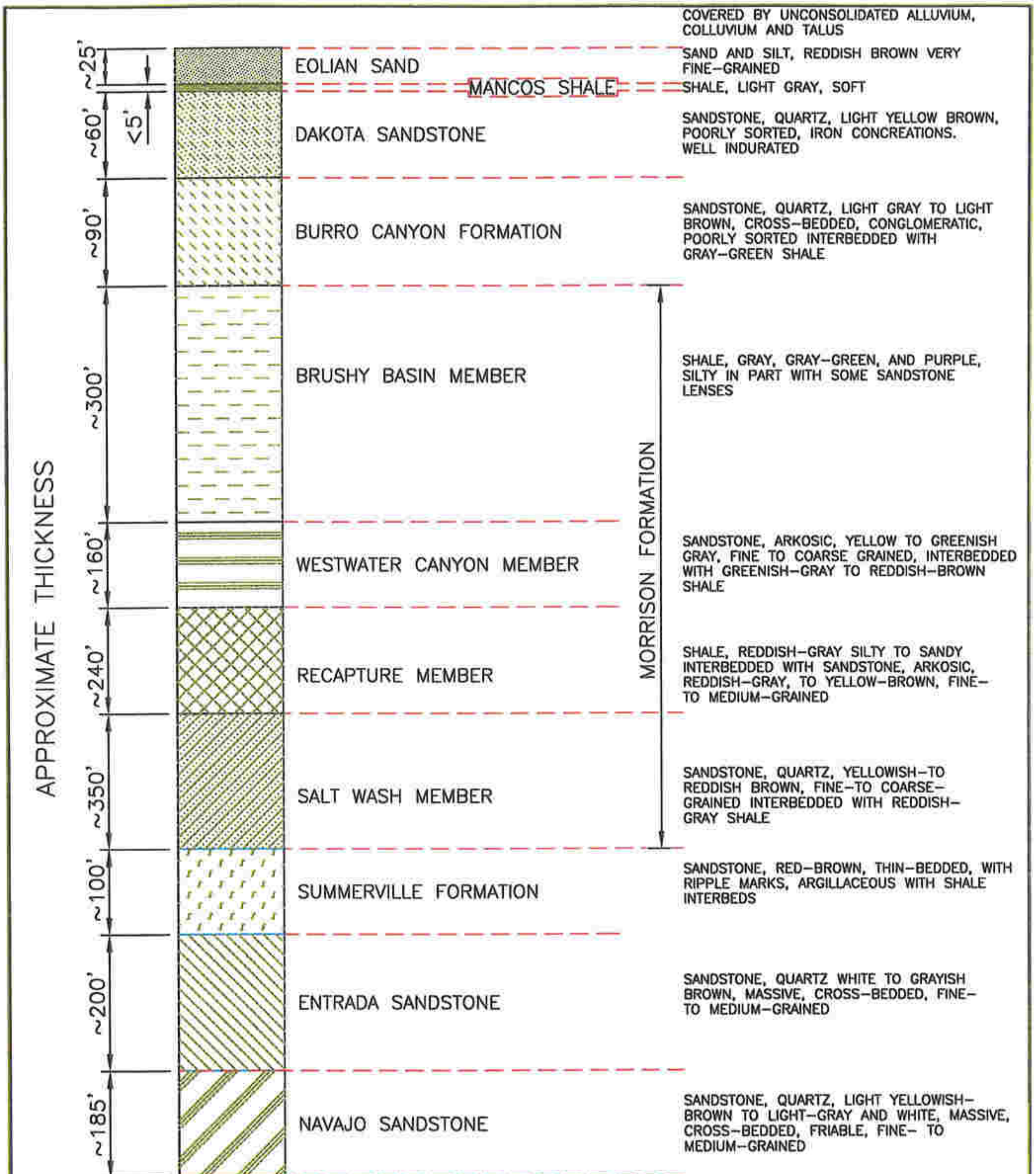
The Mill is more specifically located on White Mesa and rests on alluvial windblown silt and sand which covers sandstones and shales of Jurassic and Cretaceous age. The surface of the mesa is nearly flat, with a surface relief of 98 ft. The maximum relief between White Mesa and the adjacent Cottonwood Canyon is about 750 ft.

3.4.3 Seismicity

The historical record of seismicity for the region is about 150 years old. Between 1853 and 1986, approximately 1,200 seismic events were recorded within 200 miles of the Mill site. The nearest of these events occurred in the Glen Canyon Recreation Area, 63 miles away, and at a location approximately 53 miles to the northeast of the site. An intensity V (Modified Mercalli Scale) event occurred on August 29, 1941, just east of Durango, Colorado, 99 miles away. In the FES (Section 2.7.3) NRC staff concluded that, based on the region's seismic history, the probability of a major damaging earthquake occurring at or near the site is remote.

3.4.4 Mineral Resources

There are no known mineral resources of any significance at the Mill site. However, there has been some exploration for oil and gas in the nearby vicinity.



Taken from Stratigraphic Section near Water Well #3

Denison Mines (USA) Corp.

Project	WHITE MESA MILL		
REVISIONS	County:	State: UT	
Date / By	Location:		
	Figure 3.4-2 Generalized Stratigraphy of White Mesa Mill		
	Scale: N/A	Date: Feb. 2007	figure 3.4-2.dwg
	Author: HRR	Drafted By: B.Munkhbaatar	

3.5 Soils

The majority (99%) of the soil at the Mill site consists of the Blanding soil series (1978 ER, Sect. 2.10.1.1). The remaining 1% of the site is in the Mellenthin soil series. Because the Mellenthin soil occurs only on the eastern-central edge of the site (1978 ER, Plate 2.10-1), the FES (Section 2.8) concluded that it should not be affected by Mill construction and operation.

The Mill and associated tailings cells are located on Blanding silt loam, a deep soil formed from wind-blown deposits of fine sands and silts. Although soil textures are predominantly silt loam, silty-clay-loam textures are found at some point in most profiles (Table 3.5-1). This soil generally has a 4 to 5 inches reddish-brown, silt-loam A horizon and a reddish-brown, silt-loam to silty-clay-loam B horizon. The B horizon extends downward about 12 to 16 inches where the soil then becomes calcareous silt-loam or silty-clay-loam, signifying the C horizon. The C horizon and the underlying parent material are also reddish-brown in color.

The A and B horizon both are non-calcareous with an average pH of about 8.0, whereas the C horizon is calcareous with an average pH of about 8.5. Subsoil sodium levels range up to 12% in some areas, which is close to the upper limit of acceptability for use in reclamation work (1978 ER, Sect. 2.10.1.1). Other elements, such as boron and selenium, are well below potentially hazardous levels. Potassium and phosphorus values are high in this soil (1978 ER, Table 2.10-2) and are generally adequate for plant growth. Nitrogen, however, is low (1978 ER, Sect. 2.10.1.1) and may have to be provided for successful revegetation during final reclamation.

With well-drained soils, relatively flat topography (see Section 3.8), and limited annual precipitation (see Section 3.3.1), the site generally has a low potential for water erosion. However, the flows resulting from thunderstorm activity are nearly instantaneous and, without the Mill's design controls, could result in substantial erosion. When these soils are barren, they are considered to have a high potential for wind erosion. Although the soil is suitable for crops, the low percentage of available moisture (6 to 9%) is a limiting factor for plant growth; therefore, light irrigation may be required to establish native vegetation during reclamation.

3.6 Bedrock

Subsurface conditions at the Mill site area were investigated as part of the 1978 ER by drilling, sampling, and logging a total of 28 borings which ranged in depth from 6.5 to 132.4 ft. Of these borings, 23 were augured to bedrock to enable soil sampling and estimation of the thickness of the soil cover. The remaining 5 borings were drilled through bedrock to below the perched water table, with continuous in situ permeability testing where possible and selective coring in bedrock. The soils encountered in the borings were classified and a complete log for each boring was maintained. See Appendix A of Appendix H of the 1978 ER.

Table 3.5–1
Results Of Soil Analyses At Mill Site

Soil Series (Symbol)	Profile No.	Depth (in)	Texture[1]	Availabe Moisture (%)	Water at Saturation (%)	1:1	1:5	Lime (%)	Gypsum (%)	ECe (mm/cc)	ESP (%)	Organic Carbon (%)	Phosphate (ppm)	Potassium (ppm)	CEC (Meq/100g)
Blanding (Bnd)	4	0-4	SiL	7.6	36.0	7.4	7.9	0.3	.15	1.2	1.1	.63	15	198	12.8
Ustollic Haplargid		4-12	SiCL	8.7	49.0	7.6	8.0	0.3	0.14	0.8	0.2	0.53	3	170	16.6
Fine-silty, mixed		18-40	SiCL	8.0	43.7	8.0	8.5	2.0	0.30	0.7	0.6	0.42	3	165	14.9
	9	0-5	SiL	8.9	38.7	7.6	8.1	0.3	0.17	0.9	1.8	0.53	10	182	13.1
		5-12	SiL	9.3	45.6	8.0	8.4	0.3	0.18	0.9	1.4	0.47	2	138	10.9
		18-40	SiL	8.0	38.7	8.5	9.0	3.8	0.18	1.2	11.5	0.37	2	123	11.9
		40-50	SiCL	9.0	38.9	8.8	9.2	1.6	0.18	1.0	12.5	0.26	1	161	15.9

Source: Adapted from 1978 ER Table 2.10-2.2
SiCL = silty clay loam; SiL = silt loam

Borings in the footprint of the existing tailings cells reported calcareous, red-brown sands and silts from the surface to a depth of 15 ft, averaging over 7 ft. Borings in the general area of the Mill site and the tailings cells reported calcareous, red-brown sands and silts from the surface to a depth of 14 ft, averaging over 9 ft. Downgradient of the tailings cells, calcareous sands and silts extend to a depth of 17 ft of the surface. The calcareous silts and sands of the near-surface soils grade to weathered claystones or weathered sandstones, inter-layered with weathered claystone and iron staining. At depth, the weathered claystone or weathered clayey sandstone grade into sandstone with inter-layered bands of claystone, gravel, and conglomerate. Some conglomerates are cemented with calcareous matrix.

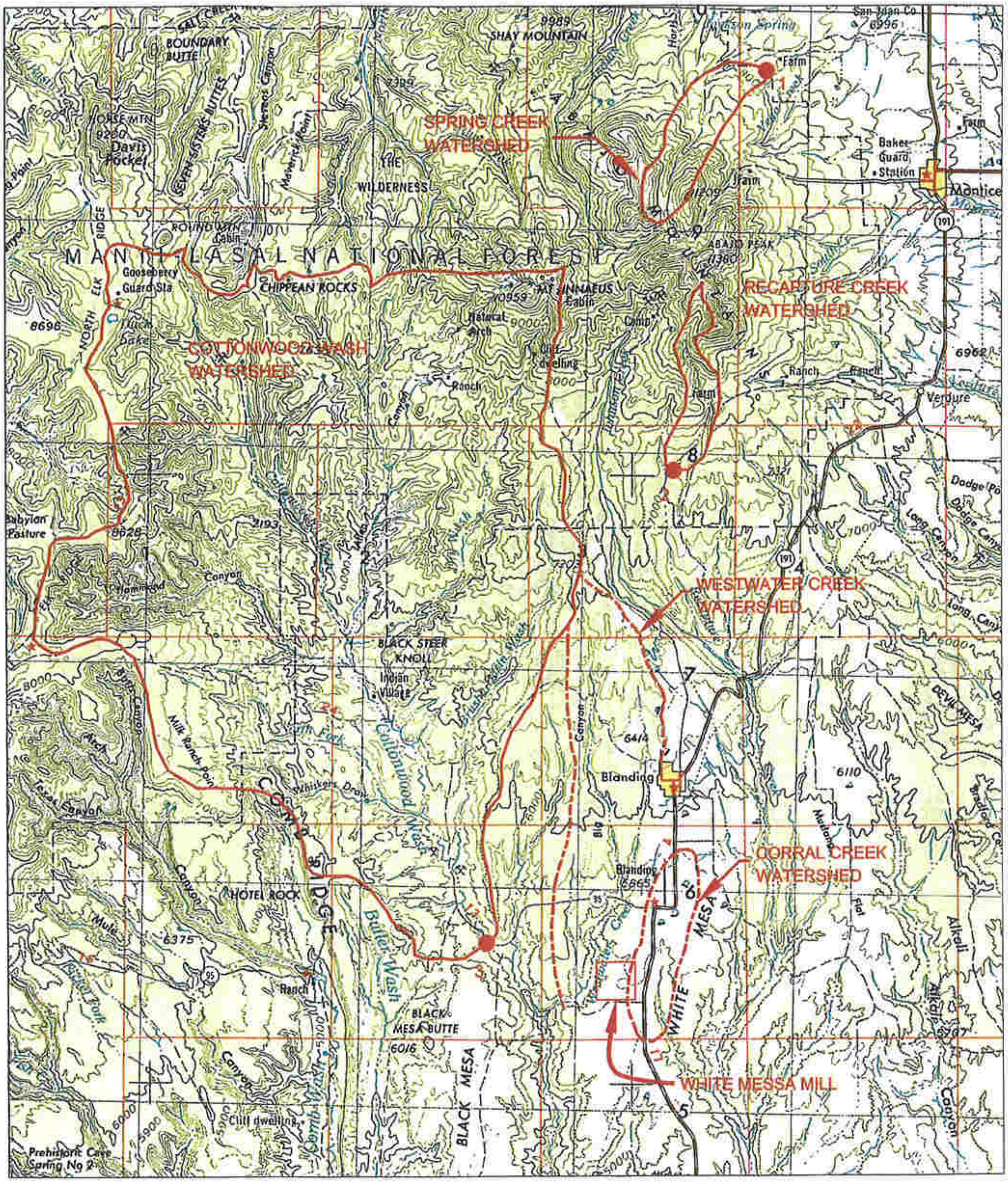
3.7 Water Resources

3.7.1 Surface Water

3.7.1.1 Surface Water Characteristics

The Mill was designed and constructed to prevent runon or runoff of storm water by a) diverting runoff from precipitation on the Mill site to the tailings cells; and b) diverting runoff from surrounding areas away from the Mill site. In addition to these designed control features, the facility has developed a "Stormwater Best Management Practices Control Plan" which includes a description of the site drainage features and the best management practices employed to assure appropriate control and routing of stormwater. A copy of the Mill's Stormwater Best Management Practices Plan is included as Appendix C to the Application.

As discussed above, the Mill site is located on White Mesa, a gently sloping (1% SSW) plateau that is physically defined by the adjacent drainages which have cut deeply into regional sandstone formations. There is a small drainage area of approximately 62 acres (25 ha) above the site that could yield surface runoff to the site. Runoff from the mesa is conveyed by the general surface topography to either Westwater Creek, Corral Creek, or to the south into an unnamed branch of Cottonwood Wash. Local porous soil conditions, topography and low average annual rainfall of 13.4 inches cause these streams to be intermittently active, responding to spring snowmelt and local rainstorms (particularly thunderstorms). Surface runoff from approximately 624 acres of the Mill drains westward and is collected by Westwater Creek, and runoff from another 384 acres drains east into Corral Creek. The remaining 4,500 acres of the southern and southwestern portions of the site drain indirectly into Cottonwood Wash (1978 ER, p. 2-143). The site and vicinity drainages carry water only on an intermittent basis. The major drainages in the vicinity of the Mill are depicted in Figure 3.7-1 tabulated in Table 3.7-1. Total runoff from the mesa (total yield per watershed area) is estimated to be less than 0.5 inch annually (1978 ER, p. 2-143).



- 1 USGS GAUGE NO. 09376900
- 2 USGS GAUGE NO. 09378630
- 3 USGS GAUGE NO. 09378700

International Uranium (USA) Corporation

Project	WHITE MESA MILL	
REVISIONS	County:	State: UT
Date / By	Location:	
	Figure 3.7 - 1 Drainage Map of the Vicinity of the White Mesa Mill	
Scale: 1:250,000	Date: March 2003	figure 3.7–1.dwg
Author: HRR	Drafted By:	

Table 3.7-1
Drainage Areas of Mill Vicinity and Region

Basin Description	Drainage Area	
	sq. miles	km^2
Corral Creek at confluence with Recapture Creek	5.8	15.0
Westwater Creek at confluence with Cottonwood Wash	26.6	68.8
Cottonwood Wash at USGS Gauge west of project site	≈ 205	<531
Cottonwood Wash at confluence with San Juan River	≈ 332	<860
Recapture Creek at USGS gauge	3.8	9.8
Recapture Creek at confluence with San Juan River	≈ 200	<518
San Juan River at USGS gauge downstream at Bluff, Utah	≈ 23,000	<60,000

Source: Adapted from 1978 ER, Table 2.6-3

There are no perennial surface waters on or in the vicinity of the Mill site. This is due to the gentle slope of the mesa on which the site is located, the low average annual rainfall of 13.4 inches per year at Blanding, local soil characteristics and the porous nature of local stream channels. Prior to construction, three small ephemeral catch basins were present on the site to the northwest and northeast of the Mill site.

Corral Creek is an intermittent tributary to Recapture Creek. The drainage area of that portion of Corral Creek above and including drainage from the eastern portion of the site is about 5 square miles. Westwater Creek is also an intermittent tributary of Cottonwood Wash. The Westwater Creek drainage basin covers nearly 27 square miles at its confluence with Cottonwood Wash 1.5 miles west of the Mill site. Both Recapture Creek and Cottonwood Wash are similarly intermittently active, although they carry water more often and for longer periods of time due to their larger watershed areas. They both drain to the south and are tributaries of the San Juan River. The confluences of Recapture Creek and Cottonwood Wash with the San Juan River are approximately 18 miles south of the Mill site. The San Juan River, a major tributary for the upper Colorado River, has a drainage of 23,000 square miles measured at the USGS gauge to the west of Bluff, Utah (1978 ER, p. 2-130).

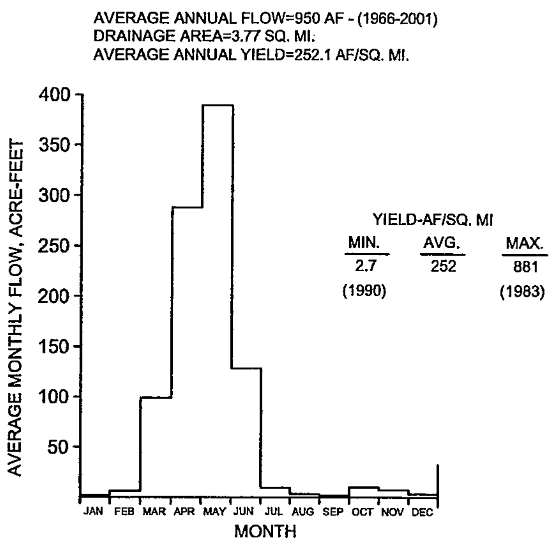
Storm runoff in these streams is characterized by a rapid rise in flow rates, followed by rapid recession primarily due to the small storage capacity of the surface soils in the area. For example, on August 1, 1968, a flow of 20,500 cubic feet per second was recorded in Cottonwood Wash near Blanding. The average flow for that day, however, was only 4,340 cfs. By August 4, the flow had returned to 16 cfs (1978 ER, p. 2-135). Monthly streamflow summaries as updated from Figure 2.4 of the FES are presented in Figure 3.7-2 for Cottonwood Wash, Recapture Creek and Spring Creek. Flow data are not available for the two smaller water courses closest to the Mill site, Corral Creek and Westwater Creek, because these streams carry water infrequently and only in response to local heavy rainfall and snowmelt, which occurs primarily in the months of

April, August, and October. Flow typically ceases in Corral Creek and Westwater Creek within 6 to 48 hours after precipitation or snowmelt ends.

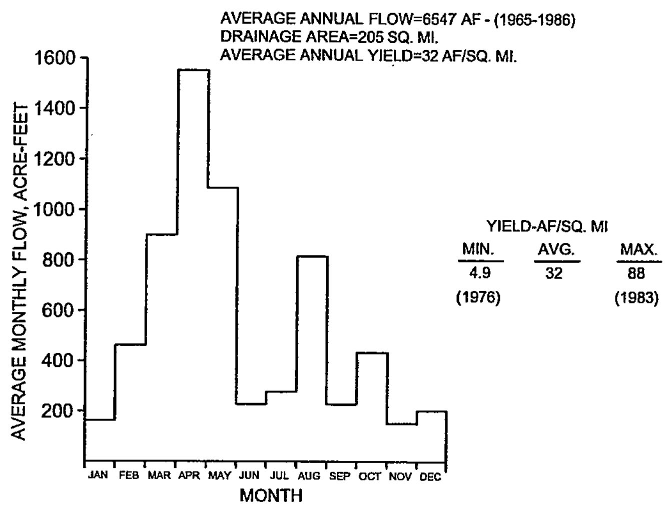
3.7.1.2 Surface Water Background Quality as of the Date of the FES

Sampling of surface water quality in the Mill vicinity began in July 1977 and continued through March 1978. Baseline data describe and evaluate existing conditions at the Mill site and vicinity at that time. Sampling of the temporary on-site surface waters (two catch basins) was attempted at that time but without success because of the lack of naturally occurring water in these basins. Sampling of ephemeral surface waters in the vicinity was possible only during major precipitation events, as these streams are normally dry at other times. See FES Section 2.6.1.2. The locations of the surface water sample sites used prior to Mill operations are presented in Figure 3.7-3.

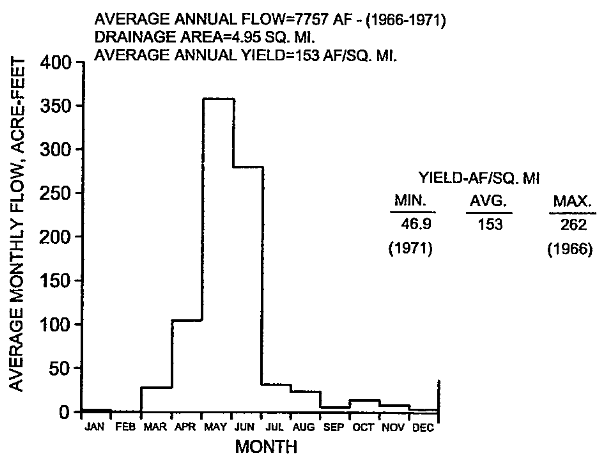
As noted in the FES, natural surface water quality in the vicinity of the Mill is generally poor, as shown by the data in Table 2.22 of the FES and Table 3.7-2. Waters in Westwater Creek (S1R and S9) were characterized at the time of the FES by high total dissolved solids (TDS) (mean of 674 mg/liter) and sulfate levels (mean of 117 mg of SO_4 per liter). The waters were typically hard (total hardness measured as $CaCO_3$; mean 223 mg/liter) and had an average pH of 8.25. Estimated water velocities for Westwater Creek averaged 0.3 fps at the time of sampling. Samples from Cottonwood Wash (S8R) at the time of the FES were generally similar in quality to Westwater Creek water samples, although the TDS and sulfate levels were lower (TDS averaged 264 mg/liter; SO_4 averaged 40 mg/liter) during heavy spring flow conditions (80 fps water velocity). During heavy runoff, the concentration of total suspended solids in these streams increased sharply to values in excess of 1,500 mg/liter (Table 3.7-2). High concentrations of certain trace elements were measured in some sampling areas. Levels of mercury (total) were reported as high as 0.002 mg/liter (S3R, 7/25/77; S8R, 7/25/77). Total iron measured in the pond (S5R, 11/10/77) was 9.4 mg/liter. The FES concluded (Section 2.6.1.2 of the FES) that these values appear to reflect groundwater quality in the vicinity and are probably due to evaporative concentration and not due to human perturbation of the environment. Corral Creek was also sampled at the time of the FES, but it has not been included in subsequent operational monitoring at the Mill. See Table 2.22 of the FES for sampling results for Corral Creek.



RECAPTURE CREEK NEAR BLANDING
USGS GAUGE 09378630



COTTONWOOD WASH NEAR BLANDING
USGS GAUGE 09378700



SPRING CREEK ABOVE DIVERSIONS,
USGS GAUGE 09376900

NOTES

1. FOR THE LOCATION OF WATER COURSES SUMMARIZED, SEE FIGURE 3.7-1
2. SOURCE OF DATA. WATER RESOURCES DATA RECORDS. COMPILED AND PUBLISHED BY USGS.

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Project	WHITE MESA MILL		
REVISIONS	County:	State: UT	
Date / By	Location:		
	Figure 3.7-2 Streamflow Summary Blanding, UT Vicinity		
	Scale: N/A	Date: Feb. 2007	figure 3.7–2.dwg
	Author: bm	Drafted By: B. Munkhbaatar	

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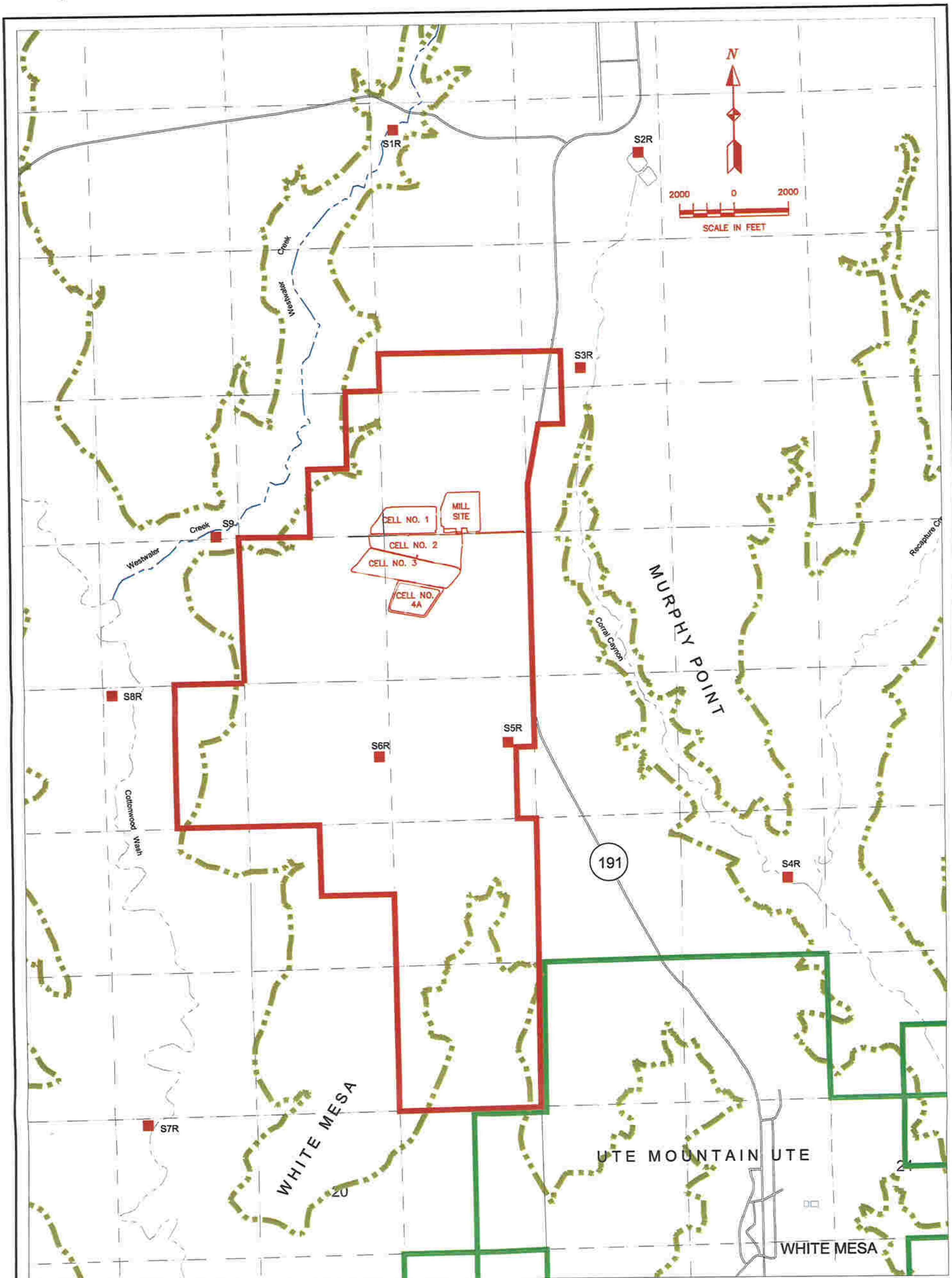

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S SURFACE WATER SAMPLING LOCATION

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Project	WHITE MESA MILL		
REVISIONS	County:	State: UT	
Date / By	Location:		
	Figure 3.7-3 Surface Water Quality Sampling Stations Prior to Mill Operations		
	Scale: as shown	Date: Feb. 2007	figure 3.7-3.dwg
	Author: bm	Drafted By: B.Munkhbaatar	

3.7.1.3 Surface Water Background Quality

Surface water samples are collected for Cottonwood Wash and Westwater Creek as part of the Mill's operational monitoring program. Samples were also taken prior to Mill construction and summarized in the FES as well as at various times and for various parameters since then. A comparison of the FES results and subsequent sampling results during Mill operation is set out in Table 3.7-2. Surface water values over time for both Cottonwood Wash and Westwater Creek are included in the Semi-Annual Effluent Reports.

Table 3.7-2
Summary of FES and Subsequent Sampling Results For Cottonwood Wash and Westwater Creek

Parameter	FES Cottonwood Wash (7/25/77-3/28/78)	Cottonwood Wash (9/16/81-2006)	FES Westwater Creek (11/10/77-3/23/78)	Westwater Creek (2/22/82-2006)
Field Specific Conductivity (μmhos/cm)	240-550	-	320-620	-
Field pH	6.6 to 8.1	-	7.6-8.3	-
Dissolved Oxygen	-	-	-	-
Temperature (°C)	6.0 to 35	-	3-14	-
Estimated Flow m/hr	0.4 to 80	-	0.28 to 39.9	-
pH	7.5 to 8.21	-	8.2 to 8.35	-
Determination, mg/liter				
TDS (@180°C)	253 to 944	10 to 803	496 to 969	93-909
Redox Potential	210 to 260	-	186 to 220	-
Alkalinity (as $CaCOS_3$)	134 to 195	76 to 257	147 to 229	230
Hardness, total (as $CaCO_3$)	148 to 195	-	117 to 289	-
Carbonate (as CO_3)	0.0	-	0.0 to 2.3	-
Aluminum, dissolved	0.16 to 3.0	-	0.1 to 4.0	-
Ammonia (as N)	<0.1 to 0.16	-	<0.1 to 0.75	-
Arsenic, total	0.02 to 0.041	-	0.007 to 0.037	-
Barium, total	0.2 to 1.2	-	<0.2 to 0.81	-
Boron, total	<0.1 to 0.2	-	<0.1 to 0.1	-
Cadmium, total	<0.002 to 0.01	-	<0.002 to 0.006	-
Calcium, dissolved	54 to 178	-	76 to 172	-
Calcium	-	37 to 71	-	94.5
Chlorine	-	-	-	-
Chloride	6 to 24	5 to 33.3	17 to 125	76
Sodium	-	18 to 104	-	160.5
Sodium, dissolved	21 to 66	-	31 to 60	-
Silver, dissolved	0.002 to <0.005	-	<0.005 to 0.006	-
Sulfate, dissolved (as SO_4)	39.7 to 564	57 to 245	85 to 163	408
Vanadium, dissolved	<0.005 to <0.01	-	<0.001 to 0.008	-
Magenese, dissolved	0.02 to 0.84	-	0.03 to 0.60	-
Chromium, total	<0.01 to 0.14	-	<0.01 to 0.60	-
Copper, total	0.005 to 0.09	-	<0.005 to 0.05	-
Fluoride, dissolved	0.2 to 0.36	-	0.2 to 0.4	-
Iron, total	5.9 to 150	-	0.28 to 44	-
Iron, dissolved	0.11 to 1.9	-	0.17 to 2.5	-
Lead, total	0.05 to 0.14	-	<0.05 to 0.1	-
Magnesium	-	10.5 to 38.1	-	23.5
Magnesium, dissolved	17 to 28	-	13 to 26	-
Mercury, total	0.00006 to 0.002	-	<0.00003 to <0.0005	-

Parameter	FES Cottonwood Wash (7/25/77-3/28/78)	Cottonwood Wash (9/16/81-2006)	FES Westwater Creek (11/10/77-3/23/78)	Westwater Creek (2/22/82-2006)
Molybdenum, dissolved	0.002 to 0.10	-	0.002 to 0.006	-
Nitrate (as N)	0.12 to 1.77	-	<0.05 to 0.05	0.05
Phosphorus, total (as P)	0.05 to 3.2	-	0.05 to 0.88	-
Potassium	-	1.77 to 4	-	-
Potassium, dissolved	1.2 to 6.9	-	2.0 to 3.2	4.05
Selenium, dissolved	<0.005 to 0.08	-	<0.005 to 0.003	-
Silica, dissolved (as SiO_2)	8 to 18	-	7 to 11	-
Strontium, total	0.34 to 0.64	-	0.44 to 0.76	-
Uranium, total	0.004 to 0.27	-	0.006 to 0.004	-
Dissolved Uranium	0.004 to 0.015	-	0.002 to 0.015	-
Zinc, dissolved	0.008 to 0.06	-	0.04 to 0.12	-
Total Organic Carbon	7 to 12	-	6 to 16	-
Chemical Oxygen Demand	61 to 163	-	23 to 66	-
Oil and Grease	2	-	1	-
Total Suspended Solids	146 to 2,025	0 to 16,400	12 to 1940	<4 to 1,190
Total Dissolve Solids		215 to 679		274
Determination (µCi/ml)				
Gross Alpha	-	<1.0E-9 to 1.0E-9	1E-10 to 4.5E-9	<1.0E-9
Gross Beta	-	-	0 to 8E-9	-
Dissolved Uranium[1]	1.02E-9 to 2.79E-9	2.23E-9 to 6.84E-6	1.03E-9 to 1.35E-9	8.8E-7
Uranium , total[5]	21.83E-7 to 2.79E-9	-	2.79E-9 to 4.06E-9	-
Suspended Uranium		<2.0E-10 to 6.09E-10	6.09E-7	6.09E-7
Th-230, dissolved	-	<2.0E-10 to 4.14E-6	0 to 1E-9	<2.0E-10
Th-230, suspended		<2.0E-10 to <2.0E-7		3.0E-10
Ra-226	-	-	2E-10	-
Ra-226, disolved		<2.0E-10 to 2.0E-9		2.0E-10
Ra-226, suspended		<2.0E-10 to <2.0E-7		<2.0E-10
Pb-210	-	-	7E-10 to 1.1E-9	-
Po-210	-	-	0 to 1E-10	-

Source: FES Table 2.22 and Mill Sample Data

[5] Calculated by Denison for activity comparison using the Specific Activity for U-nat (6.77E-7 Ci U-nat/g U-nat)

3.7.2 Groundwater Characteristics

This Section is excerpted from the Report entitled: *Site Hydrogeology and Estimation of Groundwater Travel Times In Perched Zone White Mesa Uranium Mill Site Near Blanding, Utah*, February, 2007, prepared by Hydro Geo Chem, Inc. ("HGC"), a copy of which is attached to this ER as Appendix A.

3.7.2.1 Geologic Setting

The Mill is located within the Blanding Basin of the Colorado Plateau physiographic province. Typical of large portions of the Colorado Plateau province, the rocks underlying the site are relatively underformed. The average elevation of the site is approximately 5,600 ft (1,707 m) above mean sea level (amsl).

The site is underlain by unconsolidated alluvium and indurated sedimentary rocks consisting primarily of sandstone and shale. The indurated rocks are relatively flat lying with dips generally less than 3°. The alluvial materials consist mostly of aeolian silts and fine-grained aeolian sands with a thickness varying from a few feet to as much as 25 to 30 ft (7.6 to 9.1 m) across the site. The alluvium is underlain by the Dakota Sandstone and Burro Canyon Formation, which are sandstones having a total thickness ranging from approximately 100 to 140 ft (31 to 43 m). Beneath the Burro Canyon Formation lies the Morrison Formation, consisting, in descending order, of the Brushy Basin Member, the Westwater Canyon Member, the Recapture Member, and the Salt Wash Member. The Brushy Basin and Recapture Members of the Morrison Formation, classified as shales, are very fine-grained and have a very low permeability. The Westwater Canyon and Salt Wash Members also have a low average vertical permeability due to the presence of interbedded shales. See Figure 3.4-2 for a generalized stratigraphic column for the region.

Beneath the Morrison Formation lies the Summerville Formation, an argillaceous sandstone with interbedded shales, and the Entrada Sandstone. Beneath the Entrada lies the Navajo Sandstone. The Navajo and Entrada Sandstones constitute the primary aquifer in the area of the site. The Entrada and Navajo Sandstones are separated from the Burro Canyon Formation by approximately 1,000 to 1,100 ft (305 to 335 m) of materials having a low average vertical permeability. Groundwater within this system is under artesian pressure in the vicinity of the site, and is used only as a secondary source of water at the site.

3.7.2.2 Hydrogeologic Setting

The site is located within a region that has a dry to arid continental climate, with average annual precipitation of approximately 13.4 in. Recharge to aquifers occurs primarily along the mountain fronts (for example, the Henry, Abajo, and La Sal Mountains), and along the flanks of folds such as Comb Ridge Monocline.

Although the water quality and productivity of the Navajo/Entrada aquifer are generally good, the depth of the aquifer (approximately 1,200 ft below land surface (bls)) makes access difficult.

The Navajo/Entrada aquifer is capable of yielding significant quantities of water to wells (hundreds of gallons per minute (gpm)). Water in wells completed across these units at the site rises approximately 800 ft above the base of the overlying Summerville Formation.

3.7.2.3 Perched Zone Hydrogeology

Perched groundwater beneath the site occurs primarily within the Burro Canyon Formation. Perched groundwater at the site has a generally low quality due to high total dissolved solids (TDS) in the range of 1,200 to 5,000 milligrams per liter (mg/L), and is used primarily for stock watering and irrigation in the areas upgradient (north) of the site, The saturated thickness of the perched water zone generally increases to the north of the site, increasing the yield of the perched zone to wells installed north of the site. Perched water is supported within the Burro Canyon Formation by the underlying, fine-grained Brushy Basin Member. Figure 3.7-4 is a contour map showing the approximate elevation of the contact of the Burro Canyon Formation with the Brushy Basin Member, which essentially forms the base of the perched water zone at the site. Contact elevations are based on monitoring well drilling and geophysical logs and surveyed land surface elevations. As indicated, the contact generally dips to the south/southwest beneath the site.

The permeability of the Dakota Sandstone and Burro Canyon Formation at the site is generally low. No significant joints or fractures within the Dakota Sandstone or Burro Canyon Formation have been documented in any wells or borings installed across the site (Knight Piésold, 1998). Any fractures observed in cores collected from site borings are typically cemented, showing no open space.

Based on samples collected during installation of wells MW-16 and MW-17 (the locations of the various monitoring wells are indicated on Figure 3.7-4), located immediately downgradient of the tailings cells at the site, porosities of the Dakota Sandstone range from 13.4% to 26%, averaging 20%, and water saturations range from 3.7% to 27.2%, averaging 13.5%. The average volumetric water content is approximately 3%. The permeability of the Dakota Sandstone based on packer tests in borings installed at the site ranges from 2.71E-06 centimeters per second (cm/s) to 9.12E-04 cm/s, with a geometric average of 3.89E-05 cm/s.

The average porosity of the Burro Canyon Formation is similar to that of the Dakota Sandstone. Based on samples collected from the Burro Canyon Formation at MW-16, located immediately downgradient of the tailings cells at the site, porosity ranges from 2% to 29.1%, averaging 18.3%, and water saturations of unsaturated materials range from 0.6% to 77.2%, averaging 23.4%. Titan, 1994, reported that the hydraulic conductivity of the Burro Canyon Formation ranges from 1.9E-07 to 1.6E-03 cm/s, with a geometric mean of 1.1E-05 cm/s, based on the results of 12 pump/recovery tests performed in monitoring wells and 30 packer tests performed in borings prior to that time.

Insert 3.7-4

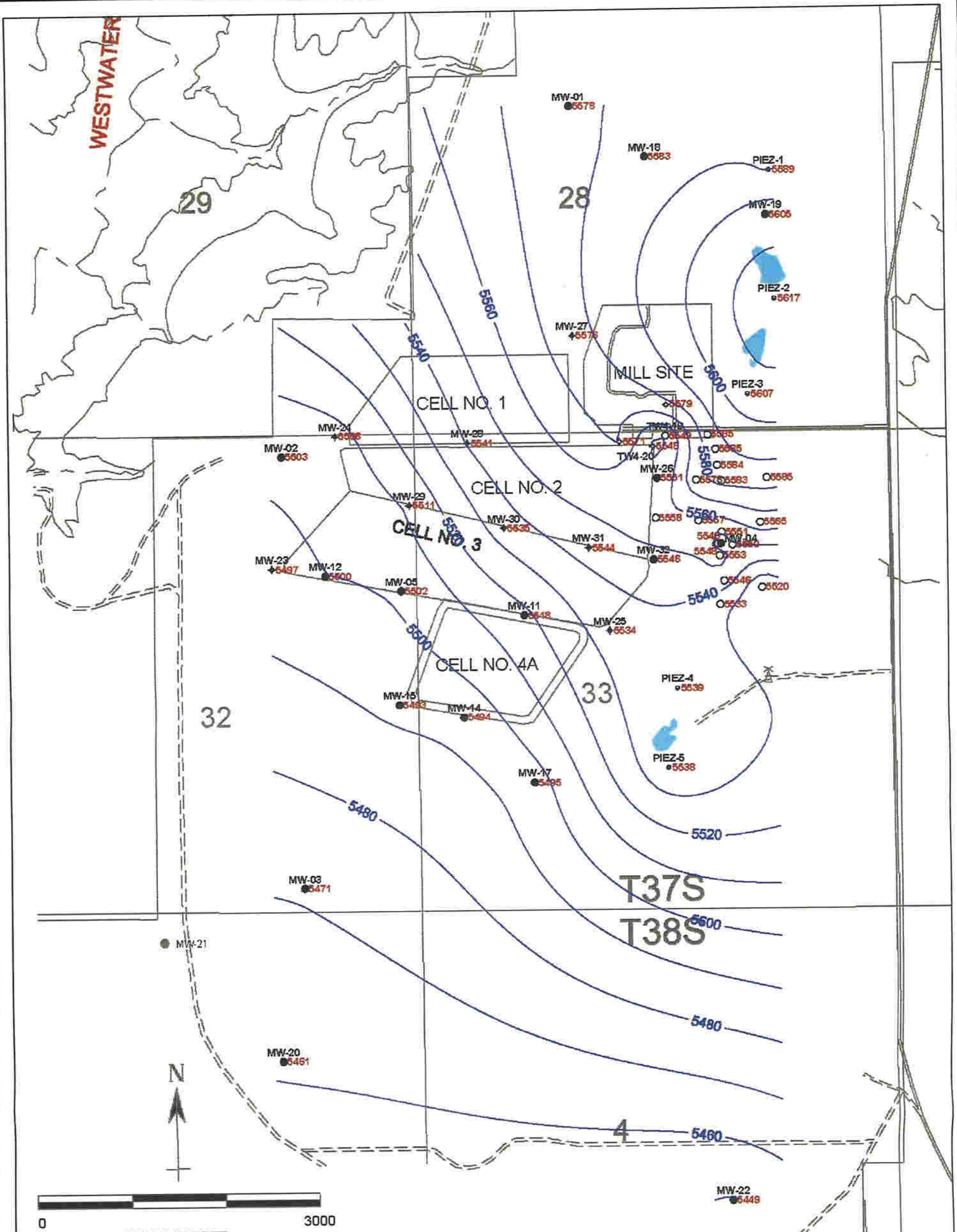
Hydraulic testing of wells MW-1, MW-3, MW-5, MW-17, MW-18, MW-19, MW-20, and MW-22 during the week of July 8, 2002, yielded average perched zone permeabilities ranging from approximately 4.0E-07 cm/s to 5.0E-04 cm/s, similar to the range reported by previous investigators at the site (HGC, 2002). Downgradient (south to southwest) of the tailings cells, average perched zone permeabilities based on tests at MW-3, MW-5, MW-17, MW-20, and MW-22 ranged from approximately 4.0E-07 to 4.0E-05 cm/s. Permeability estimates were based on pump/recovery and slug tests analyzed using several different methodologies.

A number of temporary monitoring wells have been installed at the site to investigate elevated concentrations of chloroform initially discovered at well MW-4 in 1999. Some of the conglomeratic zones encountered within the perched zone during installation of these wells are believed to be partly continuous or at least associated with a relatively continuous zone of higher permeability (IUSA and HGC, 2001). The higher permeability zone defined by these wells is generally located east to northeast of the tailings cells at the site, and is hydraulically cross-gradient to upgradient of the tailings cells with respect to perched groundwater flow. Relatively high permeabilities measured at MW-11, located on the southeastern margin of the downgradient edge of tailings Cell 3, and at MW-14, located on the downgradient edge of tailings Cell 4, of 1.4E-03 cm/s and 7.5E-04 cm/s, respectively (UMETCO, 1993), may indicate that this zone extends beneath the southeastern margin of the cells. This zone of higher permeability within the perched water zone does not appear to exist downgradient (south-southwest) of the tailings cells, however. At depths beneath the perched water table, the zone is not evident in lithologic logs of the southernmost temporary wells TW4-4 and TW4-6 (located east (cross-gradient) of Cell 3), nor is it evident in wells MW-3, MW-5, MW-12, MW-15, MW-16, MW-17, MW-20, MW-21, or MW-22, located south to southwest (downgradient) of the tailings cells, based on the lithologic logs or hydraulic testing of the wells.

Because of the generally low permeability of the perched zone beneath the site, well yields are typically low (less than 0.5 gpm), although yields of about 2 gpm may be possible in wells intercepting the higher permeability zones on the east side of the site. Sufficient productivity can, in general, only be obtained in areas where the saturated thickness is greater, which is the primary reason that the perched zone has been used on a limited basis as a water supply to the north (upgradient) of the site.

3.7.2.4 Perched Groundwater Flow

Perched groundwater flow at the site is generally to the south/southwest. Figure 3.7-5 displays the local perched groundwater elevation contours at the Mill. As indicated, the perched groundwater gradient changes from generally southwesterly in the western portion of the site to generally southerly in the eastern portion of the site.



NOTE: MW-4, TW4-19, TW4-20, and MW-26 are pumping wells

EXPLANATION

MW-20 ● 5461	perched monitoring well showing elevation in feet amsl
○ 5551	temporary perched monitoring well showing elevation in feet amsl
PIEZ-1 • 5589	perched piezometer showing elevation in feet amsl
MW-31 ✦ 5544	perched monitoring well installed April, 2005 showing elevation in feet amsl
✧ 5571	temporary perched monitoring well installed April, 2005 showing elevation in feet amsl

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	Figure 3.7-5 KRIGED PERCHED WATER LEVELS 4TH QUARTER 2006		
	Scale: as shown	Date: Feb. 2007	figure 3.7-5.dwg
	Author: BM	Drafted By: BM	

Perched water discharges in springs and seeps along Westwater Creek Canyon and Cottonwood Canyon to the west-southwest of the site, and along Corral Canyon to the east of the site, where the Burro Canyon Formation outcrops. Perched water flowing beneath the tailings cells eventually discharges in springs and seeps located in Westwater Canyon, to the south-southwest of the cells. The primary discharge point for perched water flowing beneath the tailings cells is believed to be Ruin Spring, located approximately 10,000 ft south-southwest of the Mill site, as shown in Figure 3.7-6.

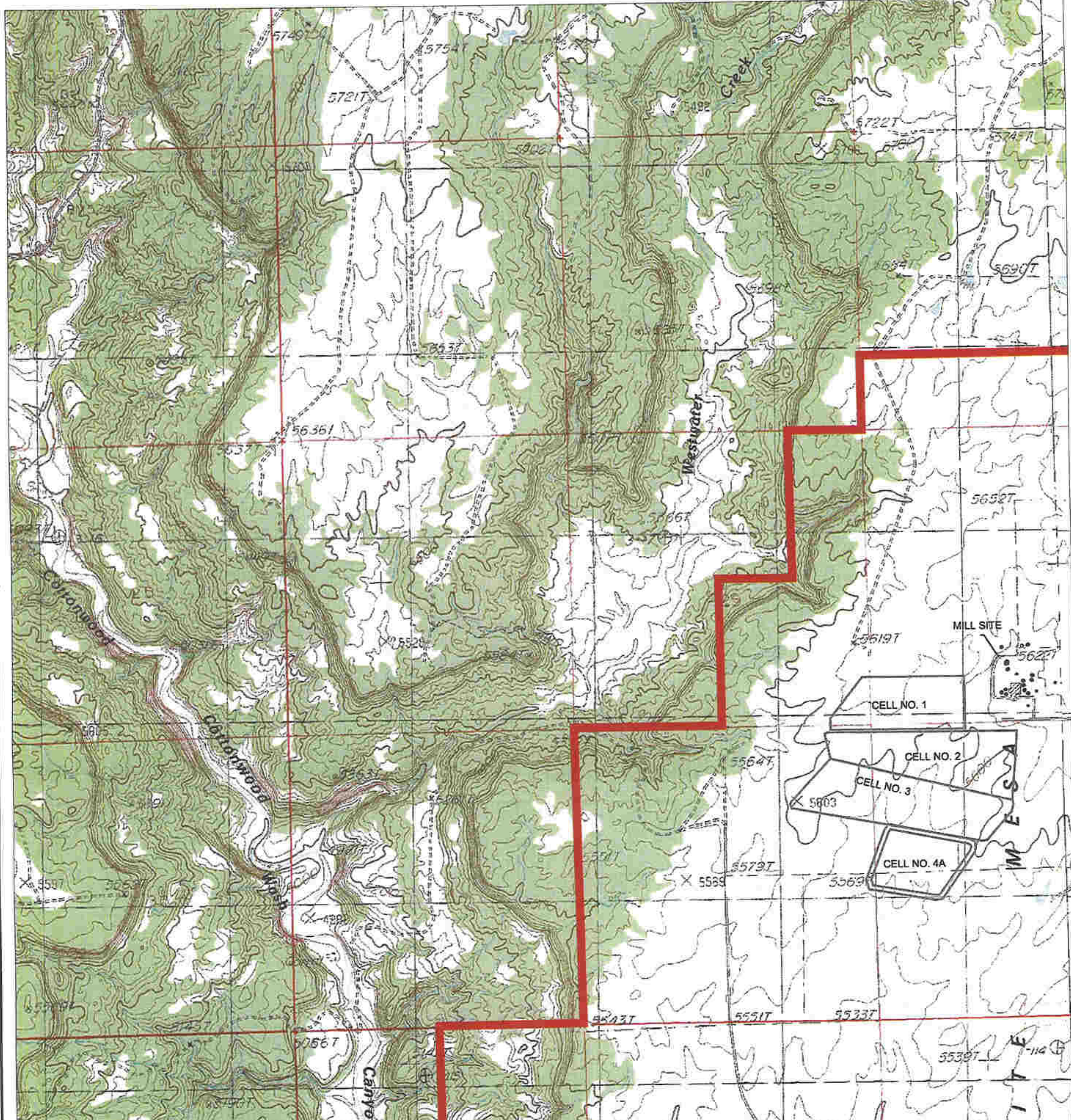
3.7.2.5 Perched Zone Hydrogeology Beneath And Downgradient Of The Tailings Cells

As of the 4th Quarter, 2006[6], perched water has been encountered at depths of approximately 50 to 115 ft bls in the vicinity of the tailings cells at the site (Figure 3.7-7). Beneath tailings Cell 3, depths to water ranged from approximately 72 ft below top of casing (btoc) east of the cell (at MW-31), to approximately 115 ft btoc at the southwest margin of the cell (at MW-23). Assuming an average depth of the base of tailings Cell 3 of 25 ft below grade, this corresponds to perched water depths of approximately 47 to 90 ft below the base of the cell, or an average depth of approximately 70 feet beneath the base of the cell.

The saturated thickness of the perched zone as of the 4th Quarter, 2006 ranged from approximately 94 ft in the northeast portion of the site to less than 5 ft in the southwest portion of the site. Beneath tailings Cell 3, the saturated thickness varies from approximately 49 ft in the easternmost corner of the cell to approximately 6 ft in the westernmost corner of the cell. South-southwest of the tailings cells, the saturated thickness ranges from less than 1 ft at MW-21 to approximately 25 ft at MW-17. The average saturated thickness south-southwest of the tailings cells, based on measurements at MW-3, MW-5, MW-12, MW-14, MW-15, MW-17, and MW-20, is approximately 14 ft. The average saturated thickness based on measurements at MW-5, MW-15, MW-3, and MW-20, which lay close to a line between the center of tailings Cell 3 and Ruin Spring, is approximately 12 ft. By projecting conditions at these wells, the average saturated thickness is estimated to be approximately 10 to 15 ft between MW-20 and Ruin Spring.

Perched zone hydraulic gradients currently range from a maximum of approximately 0.04 feet per foot (ft/ft) immediately northeast of tailings Cell 3 to less than 0.01 ft/ft downgradient of Cell 3, between Cell 3 and MW-20. The average hydraulic gradient between the downgradient edge of tailings Cell 3 and Ruin Spring was approximated by HGC to be approximately 0.012 ft/ft. HGC also estimated a hypothetical worst case average perched zone hydraulic gradient, assuming the perched water elevation to be coincident with the base of tailings Cell 3, to be approximately 0.019 ft/ft. See Section 3.2 of Appendix A.

[6] Current groundwater elevations are reported to UDEQ in the Quarterly Groundwater Reports appended to the Application. In general, sub-surface water contour conditions remain the same as those discussed above.



From USGS 7.5 minute quad sheet for Black Mesa

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Project	WHITE MESA MILL
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Date By	Location:
	Figure 3.7-6 Approximate Location of Ruin Spring
Scale: as shown	Date: Feb. 2007 figure 3.7-6.dwg
Author: bm	Drafted By: B.Munkhbaatar

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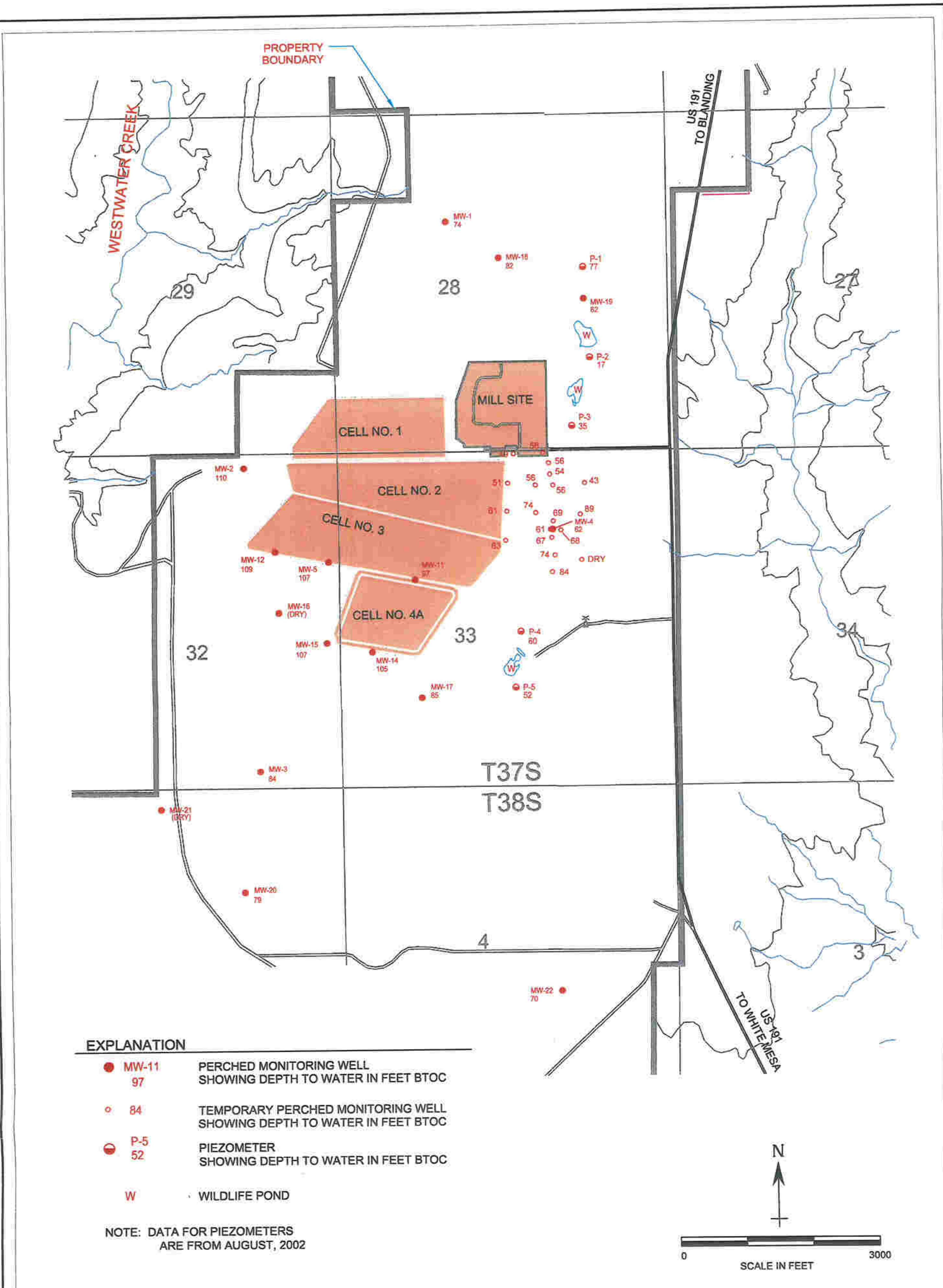

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Project	WHITE MESA MILL
REVISIONS	County: State: UT
Date By	Location:

Figure 3.7-7
Depth to Perched Water
September 2002

Scale: as shown | Date: Feb. 2007 | figure 3.7-7.dwg
Author: bm | Drafted By: B.Munkhbaatar

HGC also estimated the average permeability of the perched zone downgradient of tailings Cell 3, based on pump/recovery test and slug test data obtained from perched zone wells located along the downgradient edge of and south of Cell 3, to be between 2.39E-05 cm/s and 4.3E-05 cm/s. See Section 3.3 of Appendix A.

3.7.3 Groundwater Quality

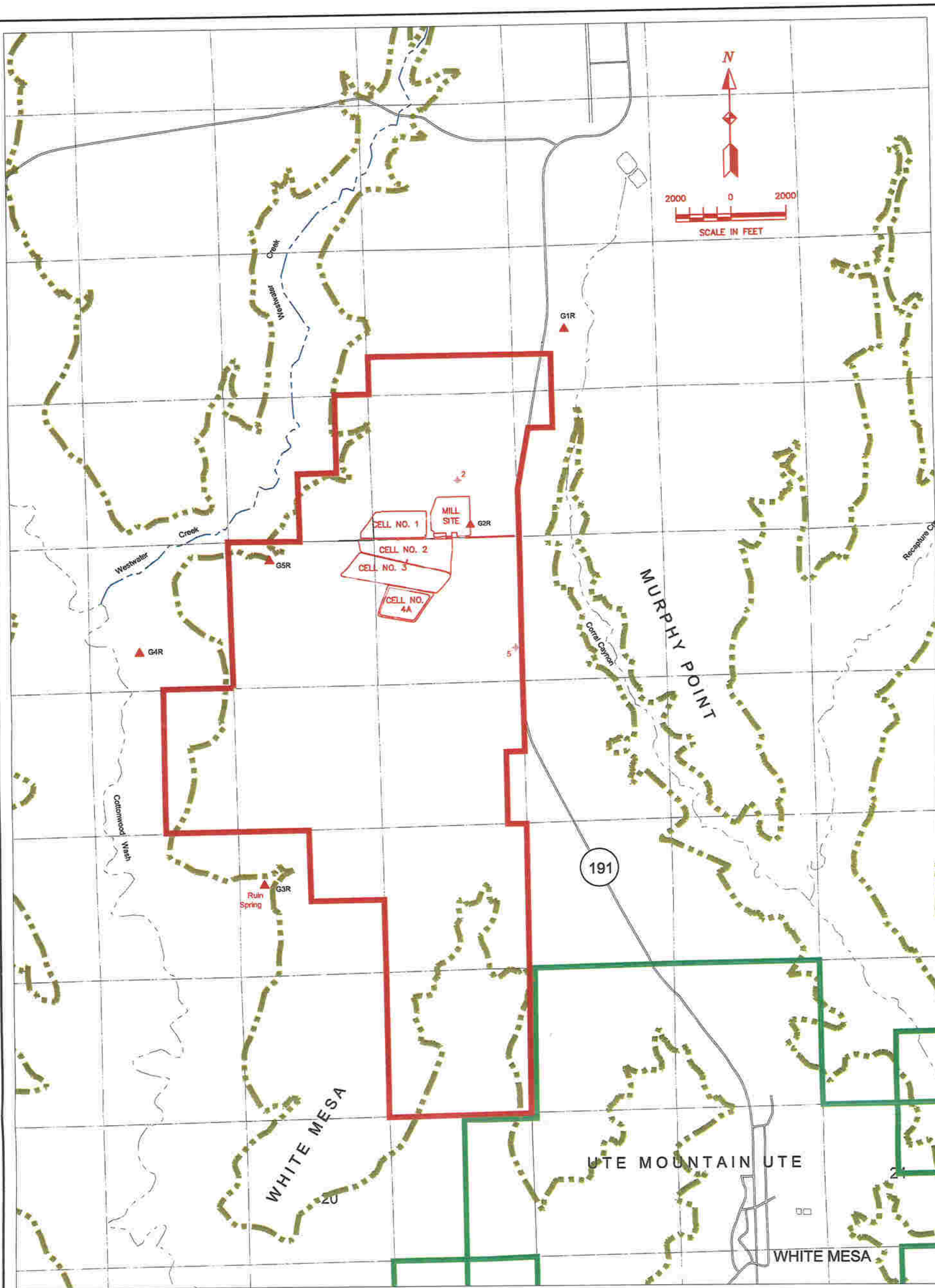
3.7.3.1 Entrada/Navajo Aquifer

The Entrada and Navajo Sandstones are prolific aquifers beneath and in the vicinity of the site. Water wells at the site are screened in both of these units, and therefore, for the purposes of this discussion, they will be treated as a single aquifer. Water in the Entrada/Navajo Aquifer is under artesian pressure, rising 800 to 900 ft above the top of the Entrada's contact with the overlying Summervillle Formation; static water levels are 390 to 500 ft below ground surface.

Within the region, this aquifer is capable of yielding domestic quality water at rates of 150 to 225 gpm, and for that reason, it serves as a secondary source of water for the Mill. Additionally, two domestic water supply wells drawing from the Entrada/Navajo Aquifer are located 4.5 miles southeast of the Mill site on the Ute Mountain Ute Reservation. Although the water quality and productivity of the Navajo/Entrada aquifer are generally good, the depth of the aquifer (>1,000 ft bls) makes access difficult.

Table 3.7-4 is a tabulation of groundwater quality of the Navajo Sandstone aquifer as reported in the FES and subsequent sampling. The total dissolved solids (TDS) range from 244 to 1,110 mg/liter in three samples taken over a period from January 27, 1977, to May 4, 1977. High iron (0.057 mg/liter) concentrations are found in the Navajo Sandstone. Because the Navajo Sandstone aquifer is isolated from the perched groundwater zone by approximately 1,000 to 1,100 ft of materials having a low average vertical permeability, sampling of the Navajo Sandstone is not required under the Mill's previous NRC Point of Compliance monitoring program or under the state's GWDP. However, samples were taken at two other deep aquifer wells (#2 and #5) on site (See Figure 3.7-8 for the locations of these wells), on June 1, 1999 and June 8, 1999, respectively, and the results are included in Table 3.7-4.

Z:\White Mesa Mill\2007 License Renewal Application\Environmental Report - Figures\figure 3.7-8.dwg, Figure 3.7-8, 02/24/2007 11:19:14 AM, Adobe PDF.pc3, 11 x 17



G4R GROUNDWATER (WELL OR SPRING) SAMPLING LOCATION

5 WATER SUPPLY WELL

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Project	WHITE MESA MILL		
REVISIONS	County:	State: UT	
Date / By	Location:		
	Figure 3.7-8 Groundwater (Well or Spring) Sampling Stations in the White Mesa Vicinity		
	Scale: as shown	Date: Feb. 2007	figure 3.7-8.dwg
	Author: bm	Drafted By: bm	

Table 3.7-4
Water Quality of Groundwater in the Mill Vicinity

Parameter	FES, Test Well (G2R) (1/27/77 - 3/23/78[1])	Well #2 6/01/99[1]	Well #5 6/08/99[1]
Field Specific Conductivity (umhos/cm)	310 to 400		
Field pH	6.9 to 7.6		
Temperature (°C)	11 to 22		
Estimated Flow m/hr (gpm)	109(20)		
pH	7.9 to 8.16		
Determination, mg/liter			
TDS (@180°C)	216 to 1110		
Redox Potential	211 to 220		
Alkalinity (as $CaCOS_3$)	180 to 224		
Hardness, total (as $CaCO_3$)	177 to 208		
Bicarbonate		226	214
Carbonate (as CO_3)	0.0	<1.0	<1.0
Aluminum		0.003	0.058
Aluminum, dissolved	<0.1		
Ammonia (as N)	0.0 to 0.16	<0.05	<0.05
Antimony		<0.001	<0.001
Arsenic, total	.007 to 0.014	0.018	<0.001
Barium, total	0.0 to 0.15	0.119	0.005
Beryllium		<0.001	<0.001
Boron, total	<0.1 to 0.11		
Cadmium, total	<0.005 to 0.0	<0.001	0.018
Calcium		50.6	39.8
Calcium, dissolved	51 to 112		
Chloride	0.0 to 50	<1.0	2.3
Sodium		7.3	9.8
Sodium, dissolved	5.3 to 23		
Silver		<0.001	<0.001
Silver, dissolved	<0.002 to 0.0		
Sulfate		28.8	23.6
Sulfate, dissolved (as SO_4)	17 to 83		
Vanadium		0.003	0.003
Vanadium, dissolved	<.002 to 0.16		
Manganese		0.011	0.032
Manganese, dissolved	0.03 to 0.020		
Chromium, total	0.02 to 0.0	0.005	0.005
Copper, total	0.005 to 0.0	0.002	0.086
Fluoride		0.18	0.18
Fluoride, dissolved	0.1 to 0.22		
Iron, total	0.35 to 2.1	0.43	0.20
Iron, dissolved	0.30 to 2.3		

[1] Zero values (0.0) are below detection limits.

Parameter	FES, Test Well (G2R) (1/27/77 - 3/23/78[1])	Well #2 6/01/99[1]	Well #5 6/08/99[1]
Lead, total	0.02 - 0.0	<0.001	0.018
Magnesium		20.4	21.3
Magnesium, dissolved	15 to 21		
Mercury, total	<.00002 to 0.0	<0.001	<0.001
Molybdenum		0.001	<0.001
Molybdenum, dissolved	0.004 to 0.010		
Nickel		<0.001	0.004
Nitrate + Nitrate as N		<0.10	<0.10
Nitrate (as N)	<.05 to 0.12		
Phosphorus, total (as P)	<0.01 to 0.03		
Potassium		3.1	3.3
Potassium, dissolved	2.4 to 3.2		
Selenium		<0.001	<0.001
Selenium, dissolved	<.005 to 0.0		
Silica, dissolved (as SiO_2)	5.8 to 12		
Strontium, total (as U)	0.5 to 0.67		
Thallium		<0.001	<0.001
Uranium, total (as U)	<.002 to 0.16	0.0007	0.0042
Uranium, dissolved (as U)	<.002 to 0.031		
Zinc		0.010	0.126
Zinc, dissolved	0.007 to 0.39		
Total Organic Carbon	1.1 to 16		
Chemical Oxygen Demand	<1 to 66		
Oil and Grease	1		
Total Suspended Solids	6 to 1940	<1.0	10.4
Turbidity		5.56	19.1
Determination (pCi/liter)			
Gross Alpha			<1.0
Gross Alpha ± precision	1.6±1.3 to 10.2±2.6		
Gross Beta			<2.0
Gross Beta ± precision	8±8 to 73±19		
Radium 226 ± precision			0.3±0.2
Radium 228			<1.0
Ra–226 ± precision	0.1±.3 to 0.6±0.4		
Th–230 ± precision	0.1±0.4 to 0.7±2.7		
Pb–210 ± precision	0.0±4.0 to 1.0±2.0		
Po–210 ± precision	0.0±0.3 to 0.0±0.8		

Source: Adapted from FES Table 2.25 with additional Mill sampling data

3.7.3.2 Perched Groundwater Zone

Perched groundwater in the Dakota/Burro Canyon Formation is used on a limited basis to the north (upgradient) of the site because it is more easily accessible. The quality of the Burro Canyon perched water beneath and downgradient from the site is poor and extremely variable. The concentrations of total dissolved solids (TDS) measured in water sampled from upgradient and downgradient wells range between approximately 1,200 and 5,000 mg/1. Sulfate concentrations measured in three upgradient wells varied between 670 and 1,740 mg/l (Titan, 1994). The perched groundwater therefore is used primarily for stock watering and irrigation.

The saturated thickness of the perched water zone generally increases to the north of the site. See the Background Groundwater Quality Report: Existing Wells For Denison Mines (USA) Corp.'s White Mesa Mill Site, San Juan County, Utah dated December 2006 prepared by Intera, Inc., Appendix B.

At the time of renewal of the Mill license by the NRC in March, 1997 and up until issuance of the Mill's Groundwater Discharge Permit ("GWDP") in March 2005, the Mill implemented a groundwater detection monitoring program to ensure compliance to 10 CFR Part 40, Appendix A, in accordance with the provisions of Mill License condition 11.3A. The detection monitoring program was in accordance with the report entitled, "Points of Compliance, White Mesa Uranium Mill," submitted by letter to the NRC dated October 5, 1994. Under that program, the Mill sampled monitoring wells MW-5, MW-11, MW-12, MW-14, MW-15 and MW-17, on a quarterly basis. Samples were analyzed for chloride, potassium, nickel and uranium, and the results of such sampling were included in the Mill's Semi-Annual Effluent Monitoring Reports that were filed with the NRC up until August 2004 and with the DRC subsequent thereto.

Prior to 1997, commencing in 1979, the Mill monitored up to 20 constituents in up to 13 wells. That program was changed to the Points of Compliance Program in 1997 because:

- The Mill and tailings system had produced no impacts to the perched zone or deep aquifer; and

- The most dependable indicators of water quality and potential cell failure were considered to be chloride, nickel, potassium and natural uranium.

(a) Groundwater Discharge Permit

On March 8, 2005, the Co-Executive Secretary of the Utah Water Quality Board issued the Mill's GWDP, which includes a groundwater monitoring program that supersedes and replaces the groundwater monitoring requirements set out in Mill License Condition 11.3A. Groundwater monitoring under the GWDP commenced in March 2005, the results of which are included in the Mill's Quarterly Groundwater and DMT Performance Standard Monitoring Reports that are filed with the Co-Executive Secretary of the Utah Water Quality Board. A copy of each such Report since March 2005 is included in this Application.

(b) Groundwater Sampling Locations and Frequency

Currently, the Mill monitors ground water for radionuclide content and other parameters required by the GWDP. Accordingly, groundwater quality is sampled for 47 constituents at the locations depicted on Figure 3.7.-5 and at the frequencies listed below:

Quarterly Groundwater Compliance Monitoring Locations

- MW-11
- MW-14
- MW-26
- MW-32

Semi-annual Groundwater Compliance Monitoring

- MW-1
- MW-18
- MW-19
- MW-2
- MW-3
- MW-5
- MW-12
- MW-15
- MW-17

New Wells

The following new monitoring wells were added under the Permit.

- MW-3A
- MW-23
- MW-24
- MW-27
- MW-28
- MW-29
- MW-30
- MW-31

These wells are being sampled quarterly to determine background. Once background is established, a determination will be made under the Permit as to which of these wells will be monitored on a semi-annual basis.

Accelerated Groundwater Monitoring

In addition to the routine quarterly and semi-annual monitoring referred to above, Denison collects accelerated samplings at varying locations in accordance with the Permit, as reported in the Quarterly Groundwater and DMT Performance Standard Monitoring Reports.

(c) Background Study

On August 28, 2006, Denison received a Notice of Violation from the Co- Executive Secretary of the Utah Water Quality Board (the "Co-Executive Secretary") which lists three violations of the GWDP. Specifically, the NOV cited a number of constituents that had been detected in groundwater monitoring wells in excess of the compliance limits set out in the GWDP. This NOV was not unexpected, because the interim groundwater protection limits set out in the GWDP were set prior to the establishment by the Co-Executive Secretary of background groundwater quality at the site. Both Denison and the Co-Executive Secretary recognized at the time of issuance of the GWDP that because background groundwater quality at the Mill had not yet been approved at that time, the Co-Executive Secretary could not determine if any constituent in groundwater is naturally occurring and therefore detectable or undetectable for purposes of selecting groundwater protection limits in each monitoring well at the site. Consequently, the Co-Executive Secretary initially assigned the groundwater protection limits as if all constituents were "undetectable". However, in the Statement of Basis for the GWDP, the Co-Executive Secretary acknowledged that after submittal and Co-Executive Secretary approval of the existing well Background GWDP, pursuant to Part I.H.3 of the GWDP, the permit can be reopened and the groundwater protection limits in the permit modified to reflect natural background. The Co-Executive Secretary also acknowledged in the Statement of Basis that this approach to set the initial limits in the GWDP does not account for natural variations in groundwater quality and that false positives in the groundwater monitoring data may occur until the Background Groundwater Quality Report is submitted, approved by the Co-Executive Secretary and the GWDP limits re-established. Recognizing that it is not possible to determine whether or not an exceedance of any of the current GWDP limits is due to natural causes prior to review and acceptance by the Co-Executive Secretary of the Background Groundwater Quality Report, the Executive Secretary and Denison agreed, in response to the NOV, on a revised date of January 2, 2007 to complete and submit the Background Groundwater Quality Report. The Background Groundwater Quality Report had not been submitted at the time of the NOV because it had taken much longer than originally anticipated by Denison to complete. This was primarily due to the massive effort required by Denison's consultants in assembling, performing quality assurance evaluations on and analyzing some 19,000 data entries that had been accumulated over the history of the Mill, but which had never been assembled into one data base.

The Background Groundwater Quality Report was prepared for Denison by Intera, Inc., and submitted to the Co-Executive Secretary on January 2, 2007, as agreed. Intera concluded in the Report that "after extensive analysis of the data, we have concluded that there have been no impacts to groundwater from Mill activities." Intera based this conclusion on a number of factors, including the following:

- There are a number of exceedances of permit limits in upgradient and far downgradient wells at the site, which cannot be considered to have been impacted by Mill operations to date. Exceedances of permit limits in monitoring wells nearer to the site itself are therefore consistent with natural background in the area. In situations where the constituent that exceeds the permit limit is not trending upward, the proper conclusion is that it is representative of natural background.

- There are numerous cases of both increasing and decreasing trends in constituents in upgradient, far downgradient, and Mill site wells, which provide evidence that there are natural forces at work that are impacting groundwater quality across the entire site.

- In almost all cases where there are increasing trends in constituents in wells at the site, there are more pronounced increasing trends in those constituents in upgradient wells. Furthermore, and more importantly, in no case is there any evidence in the wells in question of increasing trends in indicator parameters, such as chloride or fluoride, which are considered the most mobile and best indicators of potential tailings cell leakage at the site. Intera considered the combination of these factors to be conclusive evidence that all increasing trends at the site are caused by natural forces and not by Mill activities.

The Background Groundwater Quality Report (Appendix B) supports Denison's position that the exceedances of GWDP limits referred to in the NOV are due to natural background forces and that the permit limits must be adjusted accordingly, as contemplated by the GWDP.

(d) Chloroform Investigation

In May, 1999, excess chloroform concentrations were discovered in monitoring well MW-4, in the shallow perched aquifer along the eastern margin of the Mill site. Because these concentrations were above the State Ground Water Quality Standard ("GWQS") for chloroform, the Executive Secretary of the Utah Water Quality Board initiated enforcement action against the Mill on August 23, 1999 through the issuance of a Groundwater Corrective Action Order, which required completion of: 1) a contaminant investigation report to define and bound the contaminant plume, and 2) a groundwater corrective action plan to clean it up. Repeated groundwater sampling by both the Mill and DRC have confirmed the presence of chloroform in concentrations that exceed the GWQS along the eastern margin of the site in wells that are upgradient or cross gradient from the tailings cells. Other VOC contaminants have also been detected in these samples. After installation of 23 new monitoring wells at the site, groundwater studies appear to have defined the eastern and southern boundaries of the chloroform plume. The Mill is currently in the process of installing additional wells in order to define the western and northern bounds of the plume.

Based on the location of the plume and characterization studies completed to date, the contamination appears to have resulted from the operation of temporary laboratory facilities that were located at the site prior to and during construction of the Mill facility, and septic drainfields that were used for laboratory and sanitary wastes prior to construction of the Mill's tailings cells. Interim measures have been instituted in order to contain the contamination and to pump contaminated groundwater into the Mill's tailings cells. A final corrective action plan has not yet been developed.

In the Statement of Basis for the GWDP, the DRC noted that[7], while the contaminant investigation and groundwater remediation plan are not yet complete, the DRC believes that additional time is available to resolve these requirements based on the following factors: 1) hydraulic isolation found between the shallow perched aquifer in which the contamination has been detected and the deep confined aquifers which are a source of drinking water in the area, 2) the large horizontal distance and the long groundwater travel times between the existing groundwater contamination on site and the seeps and springs where the shallow aquifer discharges at the edge of White Mesa, and 3) lack of human exposure for these shallow aquifer contaminants along this travel path.

[7] See page 3 of the Statement of Basis, dated December 1, 2004.

Denison and DRC have agreed on a schedule for drilling of the additional wells necessary to define the boundaries of this plume and for completion of the contaminant investigation report and preparation of a groundwater corrective action plan.

(e) THF Study

Detectable concentrations of tetrahydrofuran ("THF") have been found in four wells at the Mill, including upgradient well MW-1, and far downgradient well MW-3, as well as wells MW-2 and MW-12 which are close to the Mill's tailings cells. Two of these wells, upgradient well MW-1 and far downgradient well MW-3 have THF concentrations that exceed the State GWQS. The two other wells, MW-2 and MW-12 that are closest to the tailings cells exhibited detectable THF concentrations that did not exceed the GWQS. Denison believes that the THF was most likely derived from PVC glues and solvents used during installation of the PVC well casings found in several monitoring wells at the facility, including each of the four wells described above. This position is consistent with the occurrence of THF in both up and far downgradient wells at the site. However, the Co-Executive Secretary has determined that further evaluation is required to determine why three other wells installed at the same time do not exhibit detectable THF concentrations. As a result, Part I.H.19 of the GWDP requires that Denison submit a work plan to examine this matter further. Such work plan was submitted to the Co-Executive Secretary and further evaluations are ongoing at this time.

3.7.4 Springs and Seeps

As discussed in Section 3.7.2.4, perched groundwater at the Mill site discharges in springs and seeps along Westwater Creek Canyon and Cottonwood Canyon to the west-southwest of the site, and along Corral Canyon to the east of the site, where the Burro Canyon Formation outcrops. Water samples have been collected and analyzed from springs and seeps in the Mill vicinity as part of the baseline field investigations reported in the 1978 ER (See Table 2.6-6 in the 1978 ER).

During the period 2003-2004, Denison implemented a sampling program for seeps and springs in the vicinity of the Mill which had been sampled in 1978, prior to the Mill's construction. Four locations were designated for sampling, are shown on Figure 3.7-8. During the 2-year study period only two of the four locations were able to be sampled, Ruin Spring and Cottonwood Canyon. The other two locations, Corral Creek and a location west of Westwater Creek were not flowing (seeping) and samples could not be collected. With regard to the Cottonwood seep, while water was present, the volume was not sufficient to complete all determinations, and only organic analyses were conducted. The results of the organic analysis did not detect any detectable organics.

Samples at Ruin Spring were analyzed for major ions, physical properties, metals, radionuclides, volatile and semi-volatile organic compounds, herbicides and pesticides, and synthetic organic compounds. With the exception of one chloromethane detection, all organic determinations were at less than detectable concentrations. The detection of chloromethane is not uncommon in groundwater and can be due to natural sources. In fact, chloromethane has been observed by Denison at detectable concentrations in field blank samples during routine groundwater sampling events. The results of sampling for the other parameters tested are shown in Table 3.7-9. The results of the 2003/2004 sampling did not indicate the presence of mill derived groundwater constituents and are representative of background conditions.

Table 3.7-9
Results of Quarterly Sampling
Ruin Spring (2003-2004)

Parameter	Ruin Spring							
	Q1-03	Q2-03	Q3-03	Q4-3	Q1-04	Q2-04	Q3-04	Q4-04
Major Ions (mg/L)								
Alkalinity	-	-	196	198	193	191	195	183
Carbon Dioxide	-	-	ND	ND	ND	ND	12	ND
Carbonate	-	-	ND	ND	ND	ND	ND	ND
Bicarbonate	-	-	239	241	235	232	238	223
Hydroxide	-		ND	ND	ND	ND	ND	ND
Calcium	153	156	149	158	158	162	176	186
Chloride	28.1	21.5	27.4	28.0	29.3	28.5	26	25
Fluoride	-	-	ND	0.5	0.5	0.6	0.6	0.6
Magnesium	34.8	34.2	31.7	34.2	35.8	35.1	37.1	38.6
Nitrogen, Ammonia As N	ND	ND	ND	ND	ND	0.06	ND	0.06
Nitrogen, Nitrate+Nitrite as N	1.6	1.5	1.4	1.4	1.73	1.85	1.34	1.7
Phosphorous	0.10	ND	-	ND	ND	ND	ND	ND
Potassium	2.6	3.3	3.3	3.9	3.4	3.6	4.0	3.7
Sodium	110	105	103	113	104	110	113	116
Sulfate	503	501	495	506	539	468	544	613
Physical Properties								
Conductivity (umhos/cm)	-	-	1440	1410	1390	1440	1320	1570
pH	-	-	7.91	7.98	-	-		-
TDS (mg/L)	-	-	1040	1000	1050	1110	1050	1070
TSS (mg/L)	-	-	13.5	ND	ND	ND	ND	ND
Turbidity (NTU)	-	-	0.16	0.13	ND	0.12	-	-
Metals-Dissolved (mg/L)								
Aluminum	ND	ND	0.40	ND	ND	ND	ND	ND
Antimony	ND	ND	ND	ND	ND	ND	ND	ND
Arsenic	0.001	ND	ND	0.001	ND	ND	ND	ND
Barium	ND	ND	ND	ND	ND	ND	ND	ND
Beryllium	ND	ND	ND	ND	ND	ND	ND	ND
Cadmium	ND	ND	ND	ND	ND	ND	ND	ND
Chromium	ND	ND	ND	ND	ND	ND	ND	ND
Copper	ND	ND	0.082	ND	ND	ND	ND	ND
Iron	ND	ND	ND	ND	ND	ND	ND	ND
Lead	ND	ND	ND	ND	ND	ND	ND	ND
Manganese	ND	ND	ND	ND	ND	ND	ND	ND
Mercury	ND	ND	ND	ND	ND	ND	ND	ND
Molybdenum	ND	ND	ND	ND	ND	ND	ND	ND
Nickel	ND	ND	ND	ND	ND	ND	ND	ND
Selenium	0.013	0.012	0.012	0.012	0.012	0.012	0.012	0.012
Silver	ND	ND	ND	ND	ND	ND	ND	ND
Thallium	ND	ND	ND	ND	ND	ND	ND	ND
Uranium	0.009	0.011	0.010	0.010	0.011	0.011	0.009	0.010

Parameter	Ruin Spring							
	Q1-03	Q2-03	Q3-03	Q4-3	Q1-04	Q2-04	Q3-04	Q4-04
Major Ions (mg/L)								
Vanadium	ND	ND	ND	ND	ND	ND	ND	ND
Zinc	0.014	ND	ND	ND	ND	ND	ND	ND
Radionuclides (pCi/L)								
Gross Alpha Minus Rn & U	-	-	-	-	ND	ND	1.4	ND
Lead 210	42	ND	ND	ND	ND	ND	ND	ND
Radium 226	0.3	ND	0.3	ND	ND	ND	1.3	ND
Thorium 230	0.3	0.2	0.5	ND	ND	ND	0.4	ND
Thorium 232	-	-	ND	ND	ND	ND	ND	-
Thorium 228	-	-	ND	ND	ND	ND	-	-

As required by Part I.H.9 of the Groundwater Discharge Permit, the Mill submitted to the Co-Executive Secretary of the Utah Water Quality Board for approval a plan for groundwater sampling and analysis of all seeps and springs found downgradient or lateral gradient from the tailings cells at the Mill. This Plan is currently under review by the Co-Executive Secretary.

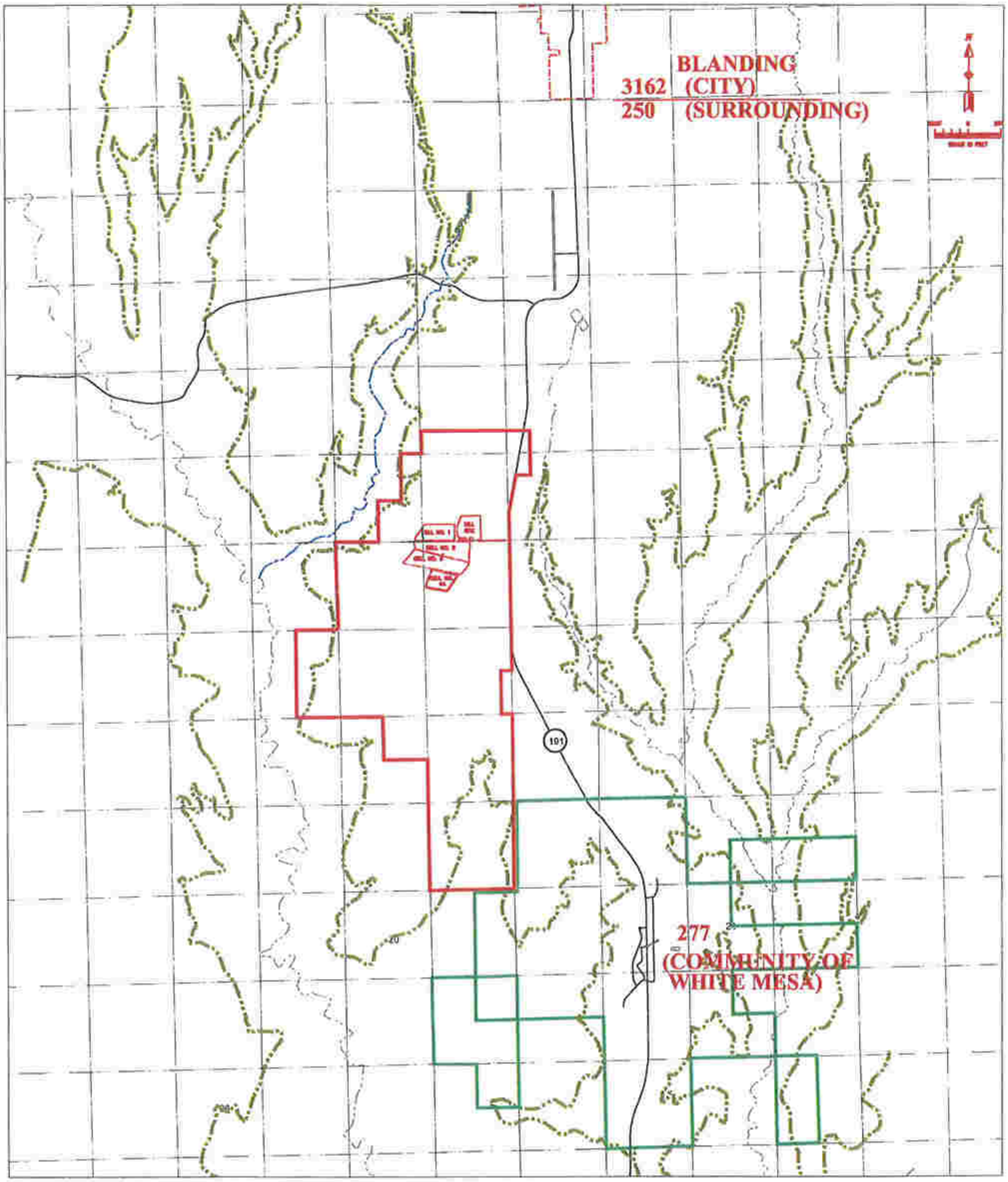
3.8 Topography

The Mill site is located on a gently sloping mesa that, from the air, appears similar to a peninsula, as it is surrounded by steep canyons and washes and is connected to the Abajo Mountains to the north by a narrow neck of land. On the mesa, the topography is relatively flat, sloping at less than one (1) percent to the south and nearly horizontal from east to west. See also Section 3.4.1 and Figure 3.7-6.

3.9 Demography and Socioeconomic Profile

3.9.1 Demography of the Area

Demographic information is generally derived from information obtained by the U.S. Census Bureau. These records are updated on a five year frequency for population centers which exceed 65,000 people and on a ten year frequency for lesser populations. As such, the local population update for the area of interest was last recorded in the year 2000, and it is that data base which was utilized to formulate the demographic information provided in this report. According to the 2000 census, the population density of San Juan County, in which the Mill is located, is 1.8 individuals per square mile. By comparison, the statewide density is greater than 27.2 persons per square mile. The town of Blanding, Utah, approximately 6 miles north of the Mill, is the largest population center near the Mill site, with 3,162 persons. Approximately 5 miles southeast of the Mill site is the White Mesa community of approximately 277 Ute Mountain Ute tribal members. See Figure 3.9-1. The Navajo Reservation is located approximately 19 miles southeast of the Mill. The nearest community on the Navajo Reservation is Montezuma Creek, a community of approximately 507 individuals in Utah. The nearest resident to the Mill is located approximately 1.5 miles to the north of the Mill, near air monitoring station BHV-1 Table 3.9-1 provides population centers located within 50 miles of the Mill site.



SCALE

0 1 2

MILES

PROPERTY BOUNDARY
RESERVATION BOUNDARY
CANYON RIM

Denison Mines (USA) Corp.			
Project	WHITE MESA MILL		
REVISIONS	County:	State: UT	
Date / By	Location:		
	Figure 3.9-1 Population in The Project Vicinity - 2000 Census		
	Scale: as shown	Date: 1999	figure 3.9–1.dwg
	Author: bm	Drafted By: B.Munkhbaatar	

Table 3.9–1
Population Centers Within 50 Miles of the Mill Site[1]

Population Center	2000 Population	Distance From Site[2] (miles)
Blanding, UT	3,162	6
White Mesa, UT	277	4
Bluff, UT	320	15
Montezuma Creek, UT	507	20
Aneth, UT	598	27
Mexican Hat, UT	88	30
Monticello, UT	1,958	27
Eastland/Ucolo, UT	249[3]	32
Dove Creek, CO	698	37
Towaoc, CO	1,097	50

Source: http://factfinder.census.gov

[1] 2000 Census
[2] Approproximate distance from Mill site by air
[3] Based on 1978 population estimate

3.9.2 Socioeconomic Profiles

San Juan County, Utah, is the largest and poorest county in Utah. As of December 2006, the unemployment rate in San Juan County was 4.9%, compared to 2.6% for Utah as a whole, and 4.5% for the nation as a whole. When operating, the Mill is one of the largest private employers in San Juan County, employing up to 60-140 full time employees. As such, the Mills employees represent a significant economic base for the city of Blanding and rural residents of San Juan County. In addition, the Company pays local taxes to San Juan County, further supporting the development of the local economic base. The Mill also provides income to local minorities, typically employing a high percentage of minority workers ranging from 45-75% Native Americans.

Since its inception in 1980, the Mill has run on a campaign basis, in each case remaining on standby pending accumulation of sufficient ore stockpiles to justify a milling campaign. Currently, Mill employees are predominantly residents of San Juan County, or residents of neighboring counties who commute to the Mill on a daily basis. Historically, the Mill has drawn upon such residents of San Juan County and neighboring counties for each milling campaign, rather than relying upon an influx of workers to the area. As a result, Mill campaigns have not given rise to any unusual demands on public services or resulted in any cultural or socioeconomic issues for the surrounding areas.

3.10 Land Use

Approximately 65.8% of San Juan County is federally owned land administered by the U.S. Bureau of Land Management, the National Park Service, and the U.S. Forest Service. Primary land uses include livestock grazing, wildlife range, recreation, and exploration for minerals, oil, and gas. Approximately 22% of the county is Native American land owned either by the Navajo Nation or the Ute Mountain Ute Tribe. The area within 5 miles of the Mill site is predominantly range land owned by residents of Blanding. The Mill site itself, including tailings cells, encompasses approximately 300 acres.

A more detailed discussion of land use at the Mill site, in surrounding areas, and in southeastern Utah, is presented in the FES (Section 2.5). Results of archeological studies conducted at the site and in the surrounding areas as part of the 1978 ER are also documented in the FES (Section 2.5.2.3).

3.11 Transportation

The FES (Section 4.8.5) contemplated that during full-scale operations, about 85 hourly Mill employees plus 20 salaried staff would travel to the Mill daily along U.S. Highway 191[8]. The FES (Section 4.8.5) also noted that heavy truck traffic would also increase substantially in the Mill area. Specifically, Section 4.8.5 of the FES noted that during the operations period, when area mining was at expected peak levels, approximately 68 round trips on local highways would be made by 30-ton ore trucks to the Mill per day (1978 ER, p. 5-34).

These calculations are consistent with an annual average Mill capacity of 2,000 tons of ore per day, which, based on typical Mill availabilities, would be expected to result in the processing of approximately 680,000 tons of ore per year. On the basis of 25 tons of ore in each truck, 27,200 round trips per year, or approximately 78 round trips per day, based on a 7-day work week (109 per day, based on a five-day week) would be transported along local highways to the Mill. For purposes of comparison to the FES, 78 roundtrips per day based on 25 tons of ore per truck is equivalent to 65 round trips per day based on 30 tons of ore per truck. The FES also contemplated that if the Mill is operating at a capacity of 680,000 tons of conventional ore per year, approximately 17 shipments of anhydrous ammonia would be made annually to the Mill in 20 ton loads; sulfuric acid shipments to the Mill would amount to about eight truck loads per day; and that amine shipments would be made at the rate of about one truck load every 45 days (FES Section 5.3.3).

Finally, the FES (Section 5.3.1) noted that refined yellowcake product is generally packaged in 55-gal, 18-gauge drums holding an average of 800 lb and classified as Transport group III Type A packaging (49 CFR Parts 170-189 and 10 CFR Part 71). Yellowcake is shipped by truck an average of 1,300 to 1,441 miles to a conversion plant, which transforms the yellowcake to uranium hexafluoride. An average yellowcake shipment contains approximately 45 drums, or 17.5 tons of yellowcake.

Based on a licensed yellowcake capacity of 4,380 tons per year (Mill License condition 10.1) a maximum of 8,760,000 pounds of yellowcake would require shipment from the Mill to conversion facilities. This would require approximately 183-275 truck shipments from the Mill per year (based on 40-60 drums per truck), or one truck every one to two days based on a seven-day week (one truck everyday or so, based on a five-day week).

[8] At the time of the FES, Highway 191 was Highway 163.

The following Table 3.11-1 illustrates the various materials shipped to and from the Mill for various periods of operation over the Mill's history (Note: shipments are indicated on Table 3.11-1 based on the assumption that the ore shipments were made during the year that the ore was processed. However, for some years actual shipments of ore took place during previous years of Mill standby, such as 1984 and 2000/2001, while the Mill was stockpiling ore in preparation for a future Mill run).

Table 3.11-1
Production and Transportation Summary

Year(s)	Received Ore (Tons)	Production		Number of Trucks							
		lbs. U_3O_8	lbs. V_2O_5	Ore	U_3O_8 Product	V_2O_5 Product	H_2SO_4	$NaClO_3$	Fuels & Oils	Kerosene Amine	Supplies Misc. Reagents
1978-1983	1,511,544	6,005,721	13,008,155	60,462	150	325	12,092	907	1,512	76	2,267
1984	0	0	0	0	0	0	0	0	24	0	260
1985-1990	2,037,209	18,759,338	18,943,167	81,488	469	474	16,298	1,222	2,037	102	3,056
1991-1994[1]	0	0	0	0	0	0	0	0	96	0	1040
1995	163,046	1,472,614	0	6,522	37	0	2,283	98	272	8	408
1996	43,553	661,722	0	1,742	17	0	610	26	73	2	109
1997	1,995	619,193	0	100	15	0	16	0	3	2	60
1998	63,296	3,000	0	3,165	0	0	127	0	127	0	190
1999	90,308	652,100	1,512,801	3,612	16	38	676	59	90	0	271
2000-2001[1]	0	0	0	0	0	0	0	0	48	0	520
2002	135,724	0	0	6,786	0	0	20	0	271	0	407
2003	36,469	0	0	1,823	0	0	7	0	73	0	109
2004	7,594	0	0	436	0	12	0	0	11	0	10
2005	2,399	46,092	0	144	0	0	216	2	24	4	35
2006	3,185	230,959	0	202	0	0	354	0	66	6	181
Total	**4,096,322**	**28,450,739**	**33,464,123**	**166,482**	**704**	**849**	**32,699**	**2,314**	**4,727**	**200**	**8,923**

[1] Mill on Standby
[2] Uranium produced in 2002 and 2003 was not shipped until 2005

From this table it is evident that a total of over 28 million pounds of U_3O_8 and over 33 million pounds of vanadium have been recovered at the Mill since its inception from over 4 million tons of conventional ores and alternate feed materials, ranging from no production in some years, to production at full capacity in other years. Average production per year in the peak years of production of 1980-1983 and 1985-1989, has been approximately 1.5 million and 3.75 million pounds of U_3O_8, respectively. The peak years of production for the Mill were 1986, 1987, and 1988 during which the Mill produced and shipped approximately 4.98, 4.8 and 4.97 million pounds of yellowcake, respectively. It can also be observed from this table that when the Mill is in full operation, as for example during the five full years of operations included in the period 1985-1990, an average of approximately 68 ore, reagent and other supply trucks arrived at the Mill each week day, and approximately one truckload of uranium and one truckload of vanadium was shipped from the Mill every three week days.

In 2003, the Utah Department of Transportation ("UDOT") provided Denison with 2002 traffic patterns. This information is set out in Table 3.11-2 relating to vehicular traffic at various locations along the route to the Mill. Because local traffic conditions remain essentially unchanged since the period of that data collection effort, the data are again used here for the purposes of this Application.

Listed below are points on the north and south boundaries of each of the cities of Moab, Monticello and Blanding in order to allow for an estimation of the average truck traffic through those cities, as well as north and south of the Mill, and points representing the northern most point on Highway 191 (Crescent Junction) and the midpoint on the route (La Sal Junction).

Table 3.11-2
Estimated 2002 Daily Car and Truck Traffic on Route 191 in Vicinity of the Mill

Location	Northbound			Southbound		
	Number of Cars	Number of Trucks	% Trucks of Total Traffic	Number of Cars	Number of Trucks	% Trucks of Total Traffic
Jct SR 262 to Aneth (South of the Mill)	1,292	259	17%	1,242	278	18%
Jct SR 95 South of Blanding (South of Blanding and North of the Mill)	1,731	365	17%	1,661	410	20%
Verdure (North of Blanding)	936	301	24%	902	342	28%
South of Monticello	1,609	609	27%	1,557	686	31%
North of Monticello	862	716	45%	862	716	45%
Jct SR 46 La Sal Jct	1,217	382	24%	1,262	481	28%
San Juan Grand County Line (South of Moab)	3,213	1,023	24%	3,380	1,149	25%
Jct SR 128 Colorado River (North of Moab)	2,152	705	25%	2,329	611	21%
Jct SR313-Jct I70 Crescent Jct	1,115	366	25%	1,207	317	21%

Source: Estimate provided by UDOT to Denison on April 9, 2003.

3.12 Ecological Resources and Biota

3.12.1 Terrestrial

3.12.1.1 Flora

The natural vegetation presently occurring within a 25-mile (40-km) radius of the Mill site is very similar to that of the region, being characterized by pinyon-juniper woodland intergrading with big sagebrush (Artemisia tridentata) communities. The pinyon-juniper community is dominated by Utah juniper (Juniperus osteosperma) with occurrences of pinyon pine (Pinus edulis) as a codominant or subdominant tree species. The understory of this community, which is usually quite open, is composed of grasses, forbs, and shrubs that are also found in the big sagebrush communities. Common associates include galleta grass (Hilaria jamesii), green ephedra (Ephedra viridis), and broom snakewood (Gutierrezia sarothrae). The big sagebrush communities occur in deep, well-drained soils on flat terrain, whereas the pinyon-juniper woodland is usually found on shallow rocky soil of exposed canyon ridges and slopes. See Section 2.9 of the 1978 ER.

Based on the work completed by Dames & Moore in the 1978 ER, no designated or proposed endangered plant species occur on or near the project site (1978 ER, Section 2.8.2.1). Of the 65 proposed endangered species in Utah at that time, six have documented distributions in San Juan County. A careful review of the habitat requirements and known distributions of these species by Dames & Moore in the 1978 ER indicated that, because of the disturbed environment, these species would probably not occur on the project site. The Navajo Sedge has been added to the list as a threatened species since the Dames & Moore study.

In completing the 2002 EA, NRC staff contacted wildlife biologists from the BLM and the Utah Wildlife Service to gather local information on the occurrences of additional species surrounding the Mill. In the 2002 EA, NRC staff concluded that the Navajo Sedge has not been observed in the area surrounding Blanding, and is typically found in areas of moisture (2002 EA at 4).

3.12.1.2 *Fauna*

Wildlife data were collected by Dames & Moore through four seasons at several locations on the Mill site, prior to construction of the Mill. The presence of a species was based on direct observations, trappings and signs such as the occurrence of scat, tracks, or burrows. A total of 174 vertebrate species potentially occur within the vicinity of the Mill (1978 ER, Appendix D), 78 of which were confirmed (1978 ER, Section 2.8.2.2).

Although seven species of amphibians are thought to occur in the area, the scarcity of surface water limits the use of the site by amphibians. Eleven species of lizards and five snakes potentially occur in the area (1978 ER, Section 2.8.2.2).

Fifty-six species of birds were observed in the vicinity of the Mill site (1978 ER, Section 2.8.2.2).

The food habits of eagles vary depending on the season and the region in which they live. Fish, carrion and waterfowl such as mallard, are consumed by eagles when available to them. The FES indicates that mallards are both common and permanent in the vicinity of the Mill (FES, Table 2.28).

Raptors are prominent in the western United States. Five species were observed in the vicinity of the site. Although no nests of these species were located at the time of the FES, all (except the golden eagle, Aquila chrysaetos) have suitable nesting habitat in the vicinity of the site. The nest of a prairie falcon (Falco mexicanus) was found about 3/4 mile (1.2 km) east of the site. Although no sightings were made of this species, members tend to return to the same nests for several years if undisturbed (1978 ER, Section 2.8.2.2).

Of several mammals that occupy the site, mule deer (Odocoileus hemionus) is the largest species. The deer inhabit the project vicinity and adjacent canyons during winter to feed on the sagebrush and have been observed migrating through the site to Murphy Point (1978 ER, Section 2.8.2.2). Winter deer use of the project vicinity, as measured by browse utilization, is among the heaviest in southeastern Utah at 25 days of use per acre in the pinyon-juniper-sagebrush habitats in the vicinity of the project site. In addition, this area is heavily used as a migration route by deer traveling to Murphy Point to winter. Daily movement during winter periods by deer inhabiting the area has also been observed between Westwater Creek and Murphy Point. The present size of the local deer herd is not known.

Other mammals present at the site include the coyote (Canis latrans), red fox (Vulpes vulpes), gray fox (Urocyon cineroargenteus), striped skunk (Mephitis mephitis), badger (taxidea taxus), longtail weasel (Mustela frenata), and bobcat (Lynx rufus). Nine species of rodents were trapped or observed on the site, the deer mouse (Peromyscus maniculatus) having the greatest distribution and abundance. Although desert cottontails (Sylvilagus auduboni) were uncommon in 1977, black-tailed jackrabbits (Lepus californicus) were seen during all seasons.

In the 2002 EA, NRC staff noted that, in the vicinity of the site, the U.S. Fish and Wildlife Service had provided the list set out in Table 3.12-1, of the endangered, threatened, and candidate species that may occur in the area around the site.

Table 3.12-1
Endangered, Threatened and Candidate Species in the Mill Area

Common Name	Scientific Name	Status
Navajo Sedge	Carex specuicola	Threatened
Bonytail Chub	Gila elegans	Endangered
Colorado Pikeminnow	Ptychocheilus lucius	Endangered
Humpback Chub	Gila cypha	Endangered
Razorback Sucker	Xyrauchen texanus	Endangered
Bald Eagle	Haliaeetus leucocephalus	Threatened
California Condor	Gymnogyps californianus	Endangered
Gunnison Sage Grouse	Centrocercus minimus	Candidate
Mexican Spotted Owl	Strix occidentalis lucida	Threatened
Southwestern Willow Flycatcher	Empidonax traillii extimus	Endangered
Western Yellow-billed Cuckoo	Coccyzus americanus occidentalis	Candidate
Black-footed Ferret	Mustela nigripes	Endangered

Source: 2002 EA

The 2002 EA also noted that, in addition, the species listed on Table 3.12-2 may occur within the Mill area that are managed under Conservation Agreements/Strategies.

Table 3.12-2
Species Managed Under Conservation Agreements/Strategies at the Mill Area

Common Name	Scientific Name
Colorado River Cutthroat Trout	Oncorhynchus clarki pleuriticus
Gunnison Sage Grouse	Centrocercus minimus

Source: 2002 EA

For the 2002 EA, NRC staff contacted wildlife biologists from the BLM and the Utah Wildlife Service to gather local information on the occurrences of these additional species surrounding the Mill. NRC staff made the following conclusions (2002 EA p. 4):

While the ranges of the bald eagle, peregrine falcon, and willow flycatcher encompass the project area, their likelihood of utilizing the site is extremely low. The black-footed ferret has not been seen in Utah since 1952, and is not expected to occur any longer in the area. The California Condor has only rarely been spotted in the area of Moab, Utah, (70 miles north) and around Lake Powell (approximately 50 miles south). The Mexican Spotted Owl is only found in the mountains in Utah, and is not expected to be on the Mesa. The Southwestern Willow Flycatcher, Western Yellow-billed Cuckoo, and Gunnison Sage Grouse are also not expected to be found in the immediate area around the Mill site.

3.12.2 Aquatic and Wetlands Biota

Aquatic habitat at the Mill site ranges temporally from extremely limited to nonexistent due to the aridity, topography and soil characteristics of the region and consequent dearth of perennial surface water. Two small stockwatering ponds are located on the Mill site a few hundred yards from the ore pad area (See Figure 3.7-7). One additional small "wildlife pond", east of Cell 4A, was completed in 1994 to serve as a diversionary feature for migrating waterfowl. Although more properly considered features of the terrestrial environment, these ponds essentially represent the total aquatic habitat on the Mill site. These ponds probably harbor algae, insects, other invertebrate forms, and amphibians. They also provide a water source for small mammals and birds. Similar ephemeral catch and seepage basins are typical and numerous to the northeast of the Mill site and south of Blanding.

Aquatic habitat in the Mill vicinity is similarly limited. The three adjacent streams (Corral Creek, Westwater Creek, and an unnamed arm of Cottonwood Wash) are only intermittently active, carrying water primarily in the spring during increased rainfall and snowmelt runoff, in the autumn, and briefly during localized but intense electrical storms. Intermittent water flow most typically occurs in April, August, and October in those streams. Again, due to the temporary nature of these steams, their contribution to the aquatic habitat of the region is probably limited to providing a water source for wildlife and a temporary habitat for insect and amphibian species.

In the 2002 EA, NRC staff concluded that (p. 4) no populations of fish are present on the project site, nor are any known to exist in the immediate area of the site. Four species of fish designated as endangered or threatened (the Bonytail Chub, Colorado Pikeminnow, Humpback Chub and Razorback Sucker) occur in the San Juan River 18 miles south of the site, which Dames & Moore noted in the 1978 ER (Section 2.8.2) is the closest habitat suitable for these species. NRC staff further concluded that there are no discharges of mill effluents to surface waters, and therefore, no impacts are expected for the San Juan River due to operations of the Mill.

3.13 Baseline Radiological Environment

3.13.1 Background Radiation

All living things are continuously exposed to ionizing radiation from a variety of sources including cosmic and cosmogenic radiation from space and external radiation from terrestrial radionuclides such as uranium, thorium and potassium-40 that occur in the earth's crust, in building materials, in the air we breathe, the food we eat, the water we drink and in our bodies.

Some exposures, such as that from potassium-40, are controlled by our body's metabolism and are relatively constant throughout the world, but exposures from sources such as uranium and thorium in soils and especially from radon in homes can vary greatly, by more than a factor of ten, depending on location.

In order to provide a context for exposures potentially attributable to radioactive emissions from processing ores and alternate feed materials at the Mill, this section provides some general background information on exposures to natural background radiation worldwide, in the United States and in the Colorado Plateau region where the Mill is located.

3.13.1.1 The World

In general terms, the worldwide breakdown of natural background radiation sources can be summarized as follows (UNSCEAR, 2000):

Cosmic and Cosmogenic	39 mrem/yr
Terrestrial	48 mrem/yr
Inhaled (Radon)	126 mrem/yr
Ingested	29 mrem /yr
Total (Average)	**242 mrem/yr (116 mrem/yr excluding radon)**

According to the United Nations Scientific Committee on the Effects of Atomic Radiation ("UNSCEAR"), the actual doses can vary considerably from the nominal values listed above, and around the world vary from this value by more than a factor of 10. For example, the dose from cosmic and cosmogenic radiation varies with altitude. The higher the altitude, the less is the protection offered by the earth's atmosphere. The dose from external gamma radiation can vary greatly depending on the levels of uranium and thorium series radionuclides in the local soil. One example is the elevated gamma fields seen on natural sands containing heavy minerals as for example in regions around the Indian Ocean, in Brazil, and New Jersey. The high variability in indoor radon concentrations is a major source of the variation in natural background dose. The variability in the dose from radon arises from many factors, including: variability in soil radium concentrations from place to place; variation both over time and location in housing stock, heating and ventilating systems; and variations in individual habits. The worldwide average ambient (i.e. outdoor) radon concentration is about 10 Bq/m^3 (UNSCEAR, 2000) and the world average concentration of U-238 and Th-232 in soils is about 0.7 pCi/g (25 Bq/kg) (NRC, 1994).

The definition of "background radiation" in 10 CFR 20.1003 specifically includes global fallout as it exists in the environment from the testing of nuclear explosive devices or from past nuclear accidents such as Chernobyl that contribute to background radiation and are not under the control of the licensee. The calculation of background radiation in this Section 3.13.1 is conservative because it does not include such fallout in background radiation for the Mill site.

3.13.1.2 United States

In the United States, nominal average levels of natural background radiation are as follows (National Council of Radiation Protection and Measurements ("NCRP"), 1987):

Cosmic and Cosmogenic	28 mrem/yr
Terrestrial	28 mrem/yr
Inhaled (Radon)	200 mrem/yr
Ingested	40 mrem /yr
Total (Average)	**296 mrem/yr (96 mrem/yr excluding radon)**

As shown above, in the United States, the average annual dose from natural background radiation is about 296 mrem/yr (including radon). The actual annual dose from natural background varies by region within the United States. For example, the average dose from external terrestrial radiation for a person living on the Colorado Plateau is in the order of 63 mrem/yr, which is considerably higher than the average dose from terrestrial radiation for a person living in Florida, where the average annual dose from external terrestrial radiation is only about 16 mrem/yr. (NRC, 1994; NCRP, 1987). No comparison made. In the United States, outdoor radon levels vary widely from about 0.1 pCi/l in New York City to about 1.2 pCi/L in Colorado Springs (NCRP, 1987), generally consistent with nominal worldwide values noted in the previous section.

3.13.1.3 Mill Site

At the Mill site, the average dose equivalent from natural background radiation was measured in 1977 to be about 142 mrem/yr. Of this 142 mrem/yr, 68 mrem/yr came from cosmic radiation, while about 74 mrem/yr came from terrestrial radiation (1978 ER).

Ingested radionuclides would contribute (about) a further 18 mrem/yr (NRC, 1979). This brings the total natural background dose from external radiation and ingested radioactivity, but exclusive of the dose from Rn-222, to about 161 mrem/yr (Table 3.13-1).

Table 3.13-1
Mill Site Average Dose From Natural Background Radiation
(Excluding Dose From Radon)

Location	Cosmic and Cosmogenic (mrem/yr)	External Terrestrial (mrem/yr)	Ingested (mrem/yr)	Average Total Dose (mrem/yr)
Blanding, Utah/White Mesa	68	74	18	160
United States	28	28	40	96
Worldwide	39	48	29	116

Source: Appendix C

Based on pre-operational measurements of ambient outdoor radon levels in the vicinity of the Mill (1978 ER), the dose from Rn-222 was estimated using generally accepted procedures to contribute an additional 250 mrem/yr. When the contribution from radon was added to other sources of natural background radiation dose, the total annual dose from natural background radiation and radioactivity to a person living in the vicinity of the Mill was estimated to be about 400 mrem/yr, considerably higher than the national average of 296 mrem/yr but not without precedent for Western U.S. locations. The increase over U.S. average background radiation exposure in the vicinity of the Mill is principally due to greater cosmic radiation exposure at higher elevations and from greater terrestrial sources (e.g. higher soil concentrations of radionuclides) common in the Western United States.

3.13.2 Radiological Impacts of Currently Licensed Operations

3.13.2.1 Introduction

The FES, in part relying on information in the 1978 ER and Supplement to the 1978 ER, provides a detailed assessment of the potential radiological impacts from the then proposed Mill (Section 4.7). As noted in the FES, there is no plan to release radioactive effluents to the surface water environment (Section 4.7.2). In addition, the FES notes (Section 4.7.2) that the possibility of seepage from the tailings impoundment to groundwater is remote and therefore, no potentially significant contribution to dose from water pathways was anticipated. As described elsewhere in this ER (Section 3.7.3.2), the groundwater monitoring program is designed to ensure early detection of any un-anticipated seepage and implementation of any necessary mitigative measures. In addition, the Background Groundwater Quality Report (Intera, 2007), together with the data collected from local surface water drainages, and data collected from seeps and springs supports the conclusion that groundwater impact from Mill sources is not evident. The environmental pathways of potential concern considered in the FES are therefore for airborne emissions.

This Section briefly discusses the radiological impacts considered in the FES potentially attributable to airborne radioactive emissions from the Mill to both nearby individuals and the entire population within 50 miles of the Mill. Consideration has also been given to the occupational exposure received by Mill employees and radiation exposure of biota other than human.

Finally, the foregoing analysis is then followed in each category by a brief discussion of actual operating results based on historic monitoring data.

3.13.2.2 Exposure Pathways for Humans

Potential environmental exposure pathways by which humans could be exposed to airborne radioactive emissions from the Mill are presented schematically in Figure 3.13-1. As noted in the previous Section, there are no realistic surface water or groundwater pathways of exposure. The doses to humans estimated in the FES are based on the proposed Mill design, the actual characteristics of the site environs, and the models and assumptions described in Section 4.7 and Appendix D of the FES.

Environmental exposure pathways of potential concern for airborne effluents from the Mill are inhalation of radioactive materials in the air, external exposure to radioactive materials in the air or deposited on ground surfaces, and ingestion of contaminated food products (vegetables and meat). The FES assessment was based on the projected air emissions shown in Table 3.13-2.

Table 3.13–2
FES Estimated Annual Releases of Radioactive Materials Resulting from the Mill
(Annual releases (Ci)[1])

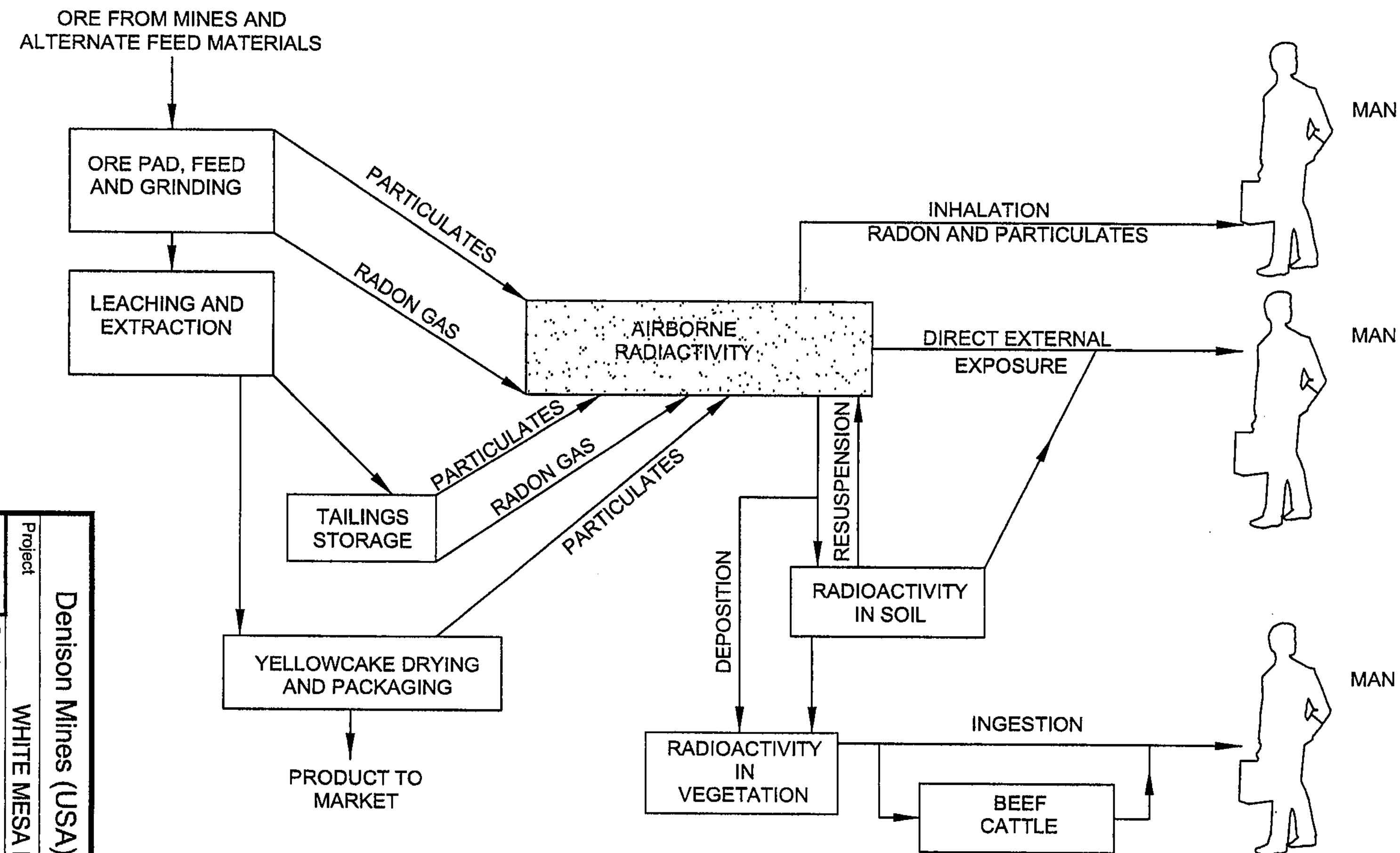
Source	U - 238	Th - 230	Ra - 226	Rn - 222
Blanding ore crusher[2]	2.6E-04	2.6E-04	2.6E-04	2.6E+00
Ore storage piles	1.7E-04	1.7E-04	1.7E-04	2.4E+02
Secondary crusher[3]	6.5E-04	6.5E-04	6.5E-04	5.2E+00
Yellowcake scrubber	2.9E-02	1.6E-03	6.2E-05	0.0
Tailings system	1.3E-02	2.0E-01	2.1E-01	8.1E+03

Source: FES Table 3.3

[1] Releases of other isotopes on the U–238 decay chain are included in the radiological impact analysis. In the front-end of the Mill, these releases are assumed to be identical to those presented here for parent isotopes. For instance, the release rate of U–234 is taken to be equal to that for U–238. The Mill process separates uranium from the tailings. Thus, the product stream (i.e., the yellowcake stream) contains most of the uranium, while the tailings contain relatively little uranium but most of the other radionuclides in the U–238 decay chain

[2] The Blanding Ore Crusher was utilized in connection with the ore buying station which was located on what became the Mill's ore pad. This ore crusher ceased operations in 1982, and is no longer in operation.

[3] The Secondary Crusher is the Mill's semi-autogenous grinding (SAG) mill, which is used for crushing conventional ores.



Denison Mines (USA) Corp.

Project: WHITE MESA MILL

REVISIONS		County:	State: UT
Date	By	Location:	

Figure 3.13-1 Source of airborne radioactive effluents from the Mill and exposure pathways to humans

Scale: N/A	Date: Feb. 2007	figure 3.13–1.dwg
Author: bm	Drafted By: B.Munkhbaatar	

3.13.2.3 Radiation Doses to Individual Members of the Public

At the time of the FES, the nearest resident lived approximately 2.8 miles north-northeast of the Mill building, near the location of air monitoring station BHV-2 (See Figure 3.3-2). A mobile home about 2.0 miles north of the Mill was occupied until just prior to the time of the FES. Currently, the nearest resident is approximately 1.6 miles north of the Mill, just north the location of air monitoring station BHV-1 (See Figure 3.3-2). BHV-1, which is located 1.2 miles north of the Mill, is the location of the "nearest potential residence" identified by NRC staff at the time of the FES and was included in the FES radiological assessment. BHV-1 remains the location of the nearest potential resident (Note that, in this ER, the people who live at the nearest residence are sometimes referred to as the nearest receptor(s).)

The nearest potential residence evaluated in the FES, and the actual current nearest residence, is along the northern border of the site, about 1.2 miles and 1.6 miles respectively, from the Mill building. All other lands abutting the Mill site to the east, south, and west are the property of the licensee, or the U.S. Bureau of Land Management. The area immediately to the north of the Mill site, the current location of the nearest residence, is used for the grazing of meat animals (beef.) It is assumed that meat animals could be grazed along the northern site boundary and eaten by the nearest actual residents. The calculated ingestion doses for consumption of beef grazed at this location are comparable to those calculated for other locations around the site at which grazing could be expected to occur (FES, Section 4.7.3).

Tables 3.13-3 and 3.13-4 present a summary of the individual dose commitments reported in the FES for the nearest actual residence at the time of the FES and the nearest potential residence, respectively. These calculations were performed by NRC staff at the time of the FES assuming the Mill was operating at 2,000 tons of conventionally mined ore per day. For details of the radiological assessment methods used by NRC see Appendix D to the FES. In brief, NRC used an NRC-modified version of the UDAD Code, the predecessor to the MILDOS Code.

Table 3.13-3
Comparison of FES Modeled Dose Commitments to Then Applicable Radiation Protection Standards at the Nearest Actual Residence at the Time of the FES (2.8 Miles North-Northeast)

NRC regulation at Time of FES (10CFR Part 20)			
Organ	Estimated Dose (mrem/yr)	Applicable Limit (mrem/yr)	Fraction of Limit
Total body	2.4	500	0.005
Bone	16	3000	0.005
Lung	3.2	1500	0.002
Bronchial epithelium	0.00015 WL[1]	0.033 WL[1]	0.005
Then Proposed EPA standard (40 CFR Part 190)[2]			
Organ	Estimated Dose (mrem/yr)	Applicable Limit (mrem/yr)	Fraction of Limit
Total body	1.4	25	0.06
Bone	15	25	0.60
Lung	2.2	25	0.09
Bronchial epithelium	19	Not Limited	-

Source: FES Table 4

[1] Radiation standards for exposure to Rn–222 and its short-lived daughters are expressed in terms of working level (WL) concentrations. One WL is the amount of any combination of short-lived radioactive daughters of Rn–222 in 1 liter of air that will release 1.3E+05 MeV of alpha energy during their decay to Pb-210.

[2] Doses computed for evaluation of compliance with 40 CFR Part 190 are less than total doses because dose contribution from Rn–222 released from the site, and any radioactive daughters that grow in from released Rn-222 have been eliminated. Limits in 40 CFR Part 190 do not apply to Rn–222 or its radioactive daughters.

Table 3.13–4
Comparison of Annual Dose Commitments to Nearest Potential (Actual Current) Residence (1.2 Miles North) at time of FES as Modeled in the FES With Applicable Radiation Protection Standards

NRC regulation at Time of FES (10CFR Part 20)			
Organ	**Estimated Dose (mrem/yr)**	**Applicable Limit (mrem/yr)**	**Fraction of Limit**
Total body	5.8	500	0.01
Bone	32	3,000	0.01
Lung	9.8	1,500	0.007
Bronchial epithelium	0.00036 WL[1]	0.0033WL[1]	0.01
Then Proposed EPA standard (40 CFR Part 190)[2]			
Organ	**Estimated Dose (mrem/yr)**	**Applicable Limit (mrem/yr)**	**Fraction of Limit**
Total body	2.5	25	0.1
Bone	29	25	1.2
Lung	6.5	25	0.30
Bronchial epithelium	78	Not Limited	-

Source: FES Table 4.8

[1] Radiation standards for exposure to Rn–222 and its short-lived daughters are expressed in terms of working level (WL) concentrations. One WL is the amount of any combination of short-lived radioactive daughters of Rn–222 in 1 liter of air that will release 1.3E+05 MeV of alpha energy during their decay to Pb-210.

[2] Doses computed for evaluation of compliance with 40 CFR Part 190 are less than total doses because dose contribution from Rn–222 released from the site, and any radioactive daughters that grow in from released Rn-222 have been eliminated. Limits in 40 CFR Part 190 do not apply to Rn–222 or its radioactive daughters.

The doses to individuals, predicted by NRC staff, as set out in Tables 3.13-3 and 3.13-4 were calculated for inhalation, external exposure to air and ground concentrations, and the ingestion of vegetables and meat. The dose conversion factors, used to convert intake of radioactivity taken into the body by inhalation or ingestion, to dose, actually represent the entire dose received by that individual over the fifty years following the actual intake. This dose is referred to as committed dose, or fifty-year dose commitment. The external dose conversion factors used by NRC staff assumed that the residents spent 100% of their time at the residence and were indoors 14 hours per day exposed to an external dose rate of 70% of the outdoor dose rate. This factor is intended to correct for the shielding from external gamma radiation provided by the residence.

It should be noted that the radiation dose limits for members of the public have changed since the time the FES was proposed. Since that time, NRC, in 10 CFR Part 20, has adopted an annual dose limit of 100 mrem total effective dose equivalent (TEDE) for members of the public which takes into account the radiation dose from both internal and external sources for doses attributable to licensed operations. Doses from natural background or medical radiation are excluded. This standard has been adopted by the State in R313-15-301(1)(a).

NRC concluded that all of the radiation doses estimated to the public from future operations at the Mill would be a small fraction of the then existing NRC limits.

In addition, NRC staff also compared their predicted doses to then proposed revised EPA's 40 CFR Part 190 limits, which became effective in December 1980 (and now required under 10 CFR 20.1301 (d)) and which included an annual dose equivalent limit of 25 mrem (exclusive of radon), which applies today. NRC staff concluded that the predicted annual dose equivalent dose to a receptor at either the then existing nearest residence or the potential nearest residence, would still have been a small fraction of the EPA's then proposed 25 mrem/yr dose limit. For a Mill operator, the FES indicated that the predicted dose commitment to the bone could exceed EPA's current standard of 25 mrem/yr, and recommended monitoring and if necessary, dust control programs for the Mill operator to ensure that this standard was satisfied in practice. This monitoring and procedures are in place.

In addition to these regulatory requirements, the Mill uses, to the extent practicable, procedures and engineering controls, based upon sound radiation protection principles, to achieve occupational doses and doses to members of the public as low as reasonably achievable ("ALARA"). The ALARA goals set by the Mill are intended to result in lower occupational doses and doses to members of the public than permitted under applicable regulatory standards.

3.13.2.4 Radiation dose commitments to populations

In estimating the potential dose to the population living within a 50 mile radius of the Mill, NRC staff considered the nearby population groups, including the community of White Mesa and the city of Blanding.

The FES also estimated annual doses to the projected population living within 50 miles of the Mill, as shown in Table 3.13-5, along with estimated annual doses to the same population from natural background radiation sources.

Table 3.13–5
FES Annual Population Dose Commitments Within 50 Miles of the Mill

Population doses (person-rems/year[1])		
Organ	**Mill Operations**	**Natural Background[2]**
Total body	3.4	7,500
Bone	6.4	7,500
Lung	7.1	7,500
Bronchial epithelium	132	23,000

Source: FES Table 4.7

[1] Based on a projected year-2000 population of 46,500.

[2] The natural background dose rate to the whole body was estimated in the FES to be 161 mrem/yr. The bronchial epithelium dose from naturally occurring Rn-222 was assumed in the FES to be 500 mrem/yr. See FES Section 2.10. This methodology is somewhat different than the more current methodology for calculating background radiation, as discussed in Section 3.13.1.

In reality, this population dose is likely to be over-estimated as the population within the 50 mile radius has not in fact achieved the levels forecasted in the FES. For example, the FES reports the 1977 population of San Juan County to be about 13,000 and projects a 2000 population of about 33,000 (Section 2.4.1) while the actual population of San Juan County in 2000 is about 14,400 (Source: www.factfinder.census.gov). Similarly, the current population within 50 miles (80 km) of the Mill is about 24,544, about half that assumed by NRC for its assessment of population dose commitments in the FES. In any event, NRC staff indicated in the FES that the population dose resulting from the operation of the Mill represents less than 1% of the doses from natural background sources.

3.13.2.5 Radiation Dose From Ore and Uranium Concentrate Transportation

Ore is transported from the mines in tarp-covered dump trucks of 25-ton capacity. The shipments are in accordance with the requirements of the Department of Transportation (49 CFR). The ore is not heaped in the truck beds but is evenly distributed to prevent load shifting and ore spillage during transportation. The use of a canvas cover secured over the truck bed minimizes dust loss during haulage (1978 ER, p 3-30).

The uranium concentrate (yellowcake) is transported by truck in 55-gal drums. Each uranium shipment was estimated by NRC to result in an external radiation dose to an individual of 2 mR/hr at any edge of the truckbed (FES Section 3.2.4.8), which is considered to be insignificant.

The FES concluded that, under normal operating conditions, no significant release of radioactive particulates would occur. Therefore, there would be no significant dose to the public from transportation of ore to the Mill or the transportation of yellowcake from the Mill, under normal operations.

3.13.2.6 Evaluations of Radiological Impacts From the Licensed Mill Operations

As noted in Section 4.7.5 of the FES, all radiation doses calculated for nearby residents from uranium milling operations at the Mill site are small fractions of those arising from naturally occurring background radiation. They are also small when compared to the average medical and dental x-ray exposures currently being received by the public for diagnostic purposes. Further, as noted in Section 3.13.1.3, NRC concluded in the FES that all of the radiation doses to the public from future operations at the Mill would be a small fraction of the then existing NRC limits.

In the period after the FES, NRC carried out a detailed evaluation of a generic mill (GEIS 1981) using dose calculation methods that had been updated since the FES was prepared. One outcome of the GEIS, was the development of the MILDOS code for estimating environmental radiation doses from uranium recovery operations (Strenge and Bender 1981). Since that time, the MILDOS code has continued to evolve as the science of dose estimation evolved. The most recent version of MILDOS is MILDOS AREA (Argonne 1998), which is routinely used for NRC regulatory purposes and has also been used in this assessment. In looking at the results for subsequent MILDOS runs carried out with the MILDOS and MILDOS AREA codes, it should be remembered that the dose calculation methodology has evolved between 1979 and the various versions of the MILDOS and MILDOS AREA codes that have evolved since then, and consequently the results of MILDOS runs with the various models will be different even for the same model inputs.

Subsequent dose modeling using NRC's MILDOS code was performed in 1991 for Umetco, a previous operator of the Mill, in support of the Mill's 1997 license renewal (Enecotech 1991). The modeling performed for Umetco assumed the maximal conditions shown below:

- 730,000 tons of ore per year (average of 2,147 tons per day),
- average grade of 0.53% U_3O_8,
- average uranium recovery of 94%,
- operating 24 hr/day for 340 days per year,
- 15 years of project life, and,
- a yellowcake production of 4,380 tons of U_3O_8 per year (8.8 million lb/yr).

By comparison, the dose calculations reported in the FES were for an average ore grade of 0.15% U_3O_8 and an annual yellowcake production of about 863 tons of U_3O_8. See FES, Table 3.2.

The 1991 EnecoTech MILDOS analysis was updated in 2007 using MILDOS AREA for this ER and using similar but updated input parameters. More specifically, and separate from the differing model codes, for the purposes of this ER full-capacity production at the Mill was considered under two ore processing scenarios, Arizona Strip ores (Upper Bound) and Colorado Plateau ores (Lower Bound). (Appendix C, *Dose Assessment for License Renewal Application & Environmental Report*, SENES, 2007). While the Mill is capable of operating at these maximized rates, it should be noted that the Mill has never operated at these levels (See Table 3.11-1, page 3-31 of this ER). Accordingly, actual production may be less than that modeled under these assumptions, resulting in a conservative review of potential dose to members of the public for this ER.

From the analysis described in the FES, assuming a total population of 46,500 within a 50 mile radius of the Mill, NRC staff predicted an annual population dose of about 3.4 person-rem. In the 1991 re-analysis performed by Enecotech using an updated model (MILDOS) developed by NRC for this specific type of application, and assuming a much higher ore grade and quantity of yellowcake produced, a population dose of about 2.4 person-rems per year was estimated for a population of about 9,000 assumed to live within 50 miles (80 km) of the Mill.

In addition to the population dose, the MILDOS code also calculates the concentrations of radioactive dust and radon at individual receptor locations around the Mill. The MILDOS code then compares these predicted concentrations to reference concentrations (referred to as maximum permissible concentrations; MPC's.) For the then nearest residence (located 2.8 miles north-northeast of the Mill), the 1991 EnecoTech MILDOS analysis concluded that the combined ratios of predicted air concentrations (that is concentrations of U-238, U-234, Th-230, Ra-226, Pb-210 and Rn-222 and decay products to the corresponding NRC MPC, and the estimated whole body dose was 8.2E-02 mrem, is more than 100 times smaller than the allowable total.

The MILDOS Code also calculated the 40 CFR.190 total body dose (which excludes radon). The FES reported 40 CFR 190 total body doses for people living at both the then nearest actual residence (2.8 miles north-northeast of the Mill) and for the nearest potential residence about 1.2 miles north of the Mill. These results, as well as the 1991 EnecoTech MILDOS and 2007 MILDOS AREA results are summarized in Table 3.13-6. Not surprisingly, the highest doses are predicted for the potential nearest resident with other, further away, receptors receiving lower doses. It is important to note however, that all of the doses are below regulatory levels of 25 mrem per year and small compared to the dose from natural background radiation (See Section 3.13.1). For reasons given earlier, as a result of the numerous changes to the dose calculation methodology in the intervening period, the direct comparison of the doses is of limited use. Nonetheless, it is worth noting that the 2007 MILDOS AREA modeling predicted that, except for the nearest resident estimated by the FES, doses are larger than those reported in the FES and by EnecoTech and should be considered as the current bound on potential doses arising from the processing of conventionally mined ores.

The production scenarios formulating the basis of this 2007 ER update included the following production considerations:

<u>Arizona Strip Ore</u>

- 730,000 tons of ore per year (average of 2,000 tons per day),
- average grade of 0.64 % U_3O_8,
- average uranium recovery of 94%,
- operating 24 hr/day for 365 days per year, and
- yellowcake production of 4,380 tons of U_3O_8 per year (8.8 million lb/yr).

<u>Colorado Plateau Ore</u>

- 730,000 tons of ore per year (average of 2,000 tons per day),
- average grade of 0.25% U_3O_8, 1.50% V_2O_5
- average uranium recovery of 94%,
- operating 24 hr/day for 365 days per year, and
- yellowcake production of 1,731 tons of U_3O_8 per year (3.5 million lb/yr).

Based on these production rates, the 2007 MILDOS AREA modeling projected dose to varying locations, including the nearest resident and the nearest potential resident. The results of the modeled doses, compared to earlier assessments are provided in Table 3.13-6:

Table 3.13-6
MILDOS AREA Total Effective Dose Equivalent Calculations (Excluding Radon)
(40CFR190 Annual Dose Commitments Adult, mrem/yr)
Update of 1991 EnecoTech Run

Receptor Location	FES Doses Dose (mrem/yr)[1,2]	1991 EnecoTech Doses Dose (mrem/yr)	2007 Updated Doses Dose (mrem/yr)[3]	
			Arizona Strip	Colorado Plateau
Nearest Potential Resident (BHV-1, 1.2 mi N of Mill)	2.5	0.42	0.16	0.15
Current Actual Resident (1.6 Mi N of Mill)	-	-	0.09	0.09
FES Nearest Resident (2.8 mi NNE of Mill)	1.4	0.08	-	-
Blanding (6 mi NNE of Mill)	NA	0.02	0.01	0.01
White Mesa Community (5 mi SE of Mill)	NA	0.05	0.01	0.01

Source: Appendix C

1 Dose calculation methods changed between 1979 and 1991 and therefore, the results from the FES and the 1991 EnecoTech analyses may not be directly comparable.

2 The FES provides 40 CFR 190 dose estimates only for the nearest and potential nearest (now actual nearest) receptors.

3 The updated analyses were done using the MILDOS AREA Code which was updated from the earlier MILDOS Code used by EnecoTech. Thus, the results of the two Codes are presented for historical context and doses estimated with the two Codes are not directly comparable.

The results of the 2007 MILDOS AREA modeling (See Appendix C, *Dose Assessment in Support of the License Renewal Application & Environmental Report for the White Mesa Mill, SENES Consultants Limited*, 2007) demonstrate that the Mill will remain in compliance with the dose limitations to members of the public under either of the conventional ore processing scenarios. As mentioned above, the Mill must comply with three separate standards with respect to public dose. First, the dose to any member of the public (UDEQ-R313-15-301(1)(a)) must not exceed 100 mrem/yr (including radon). Next, the dose to the nearest resident (EPA-40 CFR 190) must not exceed 25 mrem/yr to any organ (including the whole body as an organ). Finally, the Total Effective Dose Equivalent (TEDE), excluding radon to any member of the public cannot exceed 10 mrem/yr as an ALARA constraint limitation (UDEQ-R313-15-101(4)). In this regard, the Milling of either Arizona Strip or Colorado Plateau ores, at the rates and grades specified above, were well within these limits. The results of the 2007 MILDOS AREA TEDE dose estimations including and excluding radon for the nearest resident, the nearest potential resident (BHV-1), the City of Blanding, and the White Mesa Ute Community are present in Tables 3.13-7 through 3.13-10 below. With respect to the limit for individual organs to members of the public, the largest dose projected was at the BHV-1 location whereby the bone dose to the teenager is estimated 1.17 mrem/yr (4.7% of the limit) for the Arizona Strip ore scenario. The largest dose to the bronchi, across all age categories, is estimated at 1.05 mrem/yr (4.2% of the limit) for the Colorado Plateau scenario.

Table 3.13-7
2007 Arizona Strip Ore TEDE (mrem/yr)
(100 mrem Limit to any member of the Public, Including Radon)

Receptor Location	Estimated Dose (mrem/yr) by Age Category			
	Infant	Child	Teenager	Adult
Nearest Potential Resident (BHV-1)	2.94	2.15	2.25	1.97
Nearest Actual Resident	1.83	1.37	1.43	1.27
Blanding	0.19	0.16	0.16	0.15
White Mesa Ute Community	0.39	0.34	0.35	0.33

Table 3.13-8
2007 Colorado Plateau Ore TEDE (mrem/yr)
(100 mrem Limit to any member of the Public, Including Radon)

Receptor Location	Estimated Dose (mrem/yr) by Age Category			
	Infant	Child	Teenager	Adult
Nearest Potential Resident (BHV-1)	1.20	0.89	0.93	0.20
Nearest Actual Resident	0.75	0.58	0.60	0.54
Blanding	0.08	0.07	0.07	0.07
White Mesa Ute Community	0.18	0.16	0.16	0.15

Table 3.13-9
2007 Arizona Strip Ore TEDE (mrem/yr)
(10 mrem Constraint Limit to any member of the Public, Excluding Radon)

Receptor Location	Estimated Dose (mrem/yr) by Age Category			
	Infant	Child	Teenager	Adult
Nearest Potential Resident (BHV-1)	1.37	0.57	0.67	0.39
Nearest Actual Resident	0.79	0.33	0.39	0.23
Blanding	0.05	0.02	0.02	0.01
White Mesa Ute Community	0.08	0.03	0.03	0.02

Table 3.13-10
2007 Colorado Plateau Ore TEDE (mrem/yr)
(10 mrem Constraint Limit to any member of the Public, Excluding Radon)

Receptor Location	Estimated Dose (mrem/yr) by Age Category			
	Infant	Child	Teenager	Adult
Nearest Potential Resident (BHV-1)	0.54	0.22	0.26	0.16
Nearest Actual Resident	0.31	0.13	0.15	0.09
Blanding	0.02	0.01	0.01	0.01
White Mesa Ute Community	0.03	0.01	0.01	0.01

3.13.2.7 *Operational Environmental Monitoring Data*

The Mill has established monitoring programs to evaluate compliance with effluent limitations and to assess the potential for release of radioactive material into the local environment. These monitoring programs were developed and implemented at the time of Mill construction, operated with appropriate adaptation over time, and remain consistent with the Mill's Radioactive Materials License and guidelines developed by the NRC (U.S.N.R.C. Regulatory Guide 4.14, *Radiological Effluent and Environmental Monitoring at Uranium Mills-Rev. 1,* 1980). Standard Operating Procedures (SOP's) for these monitoring activities are discussed in Section 6.5 of the Application, and the Environmental Protection Manual containing the SOP's has been attached as Appendix A to the Application.

In accordance with its environmental monitoring program, the Mill monitors various environmental media and conditions near the facility. For the purposes of this ER, the data obtained over time from each of these measurement programs can be utilized to assess compliance with regulatory requirements, and as a resource to evaluate overall impact resulting from the operation. In this regard, the routine monitoring programs and locations listed in Table 13.13-8 below are employed by the Mill in accordance with its Environmental Protection Manual (See Appendix A to the Application). For specific details as to Standard Operating Procedures for sample collection activities, please refer to the Mill's Environmental Protection Manual (attached as Appendix A to the Application).

Table 13.13-11
Environmental Media Monitoring
(Location and Frequency)

Media Monitored	Frequency	Location
Airborne Particulate & Radionuclide Concentrations	Continuous	Air Monitoring Stations: -Sentinel Air Monitoring Stations North, East and South of the Mill [BHV-1 & BHV-2 (north), BHV-5 (east), and BHV-4 (south)] -A background location distant to and west of the Mill (BHV-3) -A station specifically requested by the White Mesa Ute Community south of the Mill Site (BHV-6)
External Gamma Radiation	Continuous Measurements Analyzed Quarterly	Air Monitoring Stations: -BHV-1, BHV-2, BHV-3, BHV-4, BHV-5 and BHV-6
Vegetation	Spring & Fall	Three site periphery locations: (NE, NW & SW of the Mill Site)
Stack Release Rates & Emission Radionuclide Content	Quarterly When Operating	Point Emission Sources: -Two Yellowcake Scrubbers -One Yellowcake Baghouse -One Vanadium Scrubber
Surface Water	Quarterly	Surface Drainages: -Cottonwood Creek -Westwater Creek

Media Monitored	Frequency	Location
Groundwater	Per GWDP Requirements	Quarterly -MW-11, MW-14, MW-26 and MW-32 Semi-annual -MW-1, MW-18, MW-19, MW-2, MW-3, MW-5, MW-12 and MW-17 New Wells -MW-3A, MW23, MW-24, MW-25, MW-27, MW-28, MW-29, MW-30 and MW-31 Accelerated -In addition to the routine quarterly and semi-annual monitoring referred to above, Denison collects accelerated monthly and quarterly samplings at varying locations triggered for accelerated monitoring under the conditions of the GWDE .
Soils	1st & 3rd Quarters	Air Monitoring Stations: -BHV-1, BHV-2, BHV-3, BHV-4, and BHV-5
Radon Emanation from Tailing Cells	Annually	Tailings Beaches and Soil Cover over Tailings Beaches

a) Airborne Radionuclide Monitoring

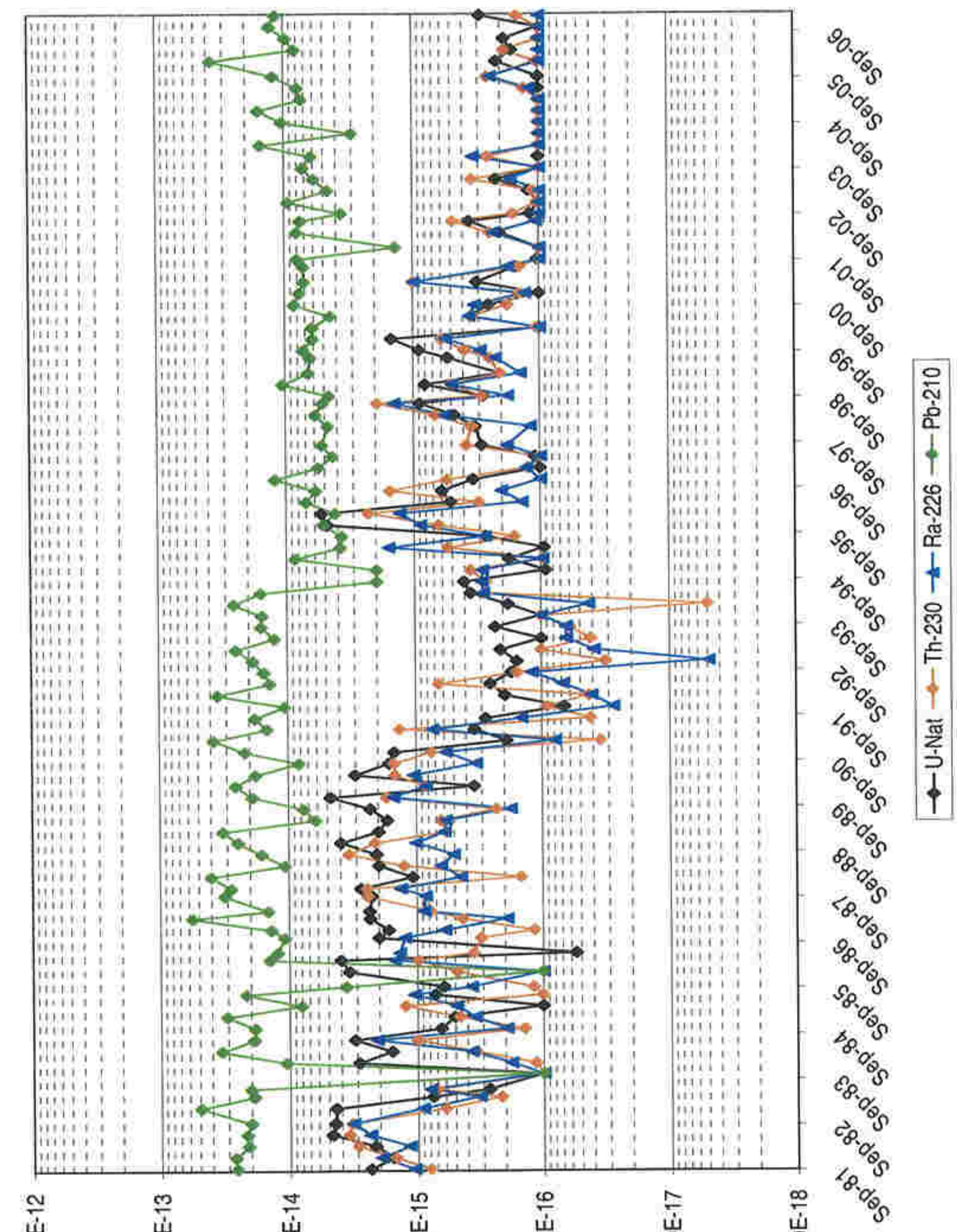
Due to the nature of the uranium processing mill functions, dust generation and offsite transport of particulate nuclides represents the exposure pathway which poses the greatest potential risk to members of the public. In order to assure compliance with the Effluent Concentration Limits listed at 10 CFR 20, Appendix B (incorporated by reference into R313-15-302) requires that uranium mills analyze particulate samples collected from the air monitoring stations for suspended radionuclide content. Accordingly, the particulate monitoring program at the Mill currently employs five high-volume continuous air monitoring stations. Four of the stations (BHV-1, BHV-2, BHV-4, and BHV-5) are required by the Mill's Radioactive Materials License. At the request of the White Mesa Ute Community, Denison also installed and operates a sixth station (BHV-6). These sampling stations serve as sentinels for airborne particulate which could potentially emanate from the Mill site. It should be noted that in addition to its general site monitoring function, location BHV-1 also serves as a conservative surrogate for concentrations at the nearest resident. While not actually located at the residence (i.e. 1/2 mile South) the sampler provides a conservative estimate for the residence because it is located between the Mill and that residence.

In addition to these monitoring stations the Mill has sampled and established an airborne particulate nuclide background for the site. More specifically, the Mill previously operated an additional sampling station (BHV-3) which was for background monitoring and was located approximately 3.5 miles west of the Mill site. With the approval of the NRC and effective November, 1995, this station (BHV-3) was removed from the active air monitoring program. At that time, Denison proposed (and the NRC determined) that a sufficient air monitoring data base had been compiled at station BHV-3, determining that the data were representative of background radionuclide concentrations. It should be noted, however, that while air sampling was discontinued at this location, gamma measurements and soil samples continue to be collected at BHV-3.

Airborne particulate monitors are operated continuously at each of the high-volume air sampling stations referenced above. Particulate sample collection filters are gathered by site technicians weekly in accordance with the Mill's environmental air sampling procedures and are composited on a quarterly basis for laboratory analyses. The analytical parameters applied to the collected filters are: Uranium-Natural activity, Thorium-230 activity, Radium-226 activity, and Lead-210 activity. In addition to the requisite nuclide determinations, particulate loading is determined for each filter and composited as a quarterly mass-loading estimate for review purposes only (See Section 3.3.2.3 above). The specific locations of the Mill's airborne particulate monitoring stations are depicted on Figure 3.3-2.

In order to evaluate the concentrations and impact of radionuclides observed at the Mill's air monitoring stations, a series of graphical illustrations was prepared. The graphs display reported data over time since the 1981 inception of the Mill's environmental air monitoring program. It should be noted that for graphical illustration purposes, values reported at zero, that is values reported at less than the prescribed detection limit and missing values were plotted as 1×10^{16} μCi/ml concentrations, the general detection limit expressed by the data set. Where other "less than" values were indicated (e.g. data where detection limits varied from 1×10^{16} μCi/ml) this detection limit concentration was utilized for plotting the data point. The intent of this data treatment convention was to provide a conservative viewable depiction of site airborne nuclide information. The conservative nature of this format is founded on the fact that the actual concentration below the detection limit cannot be determined and, as such, the plotted point is at a higher concentration than the actual (unmeasured) activity concentration of the collected sample. The graphs of air station radionuclide observations follow as figures 3.13-2 through 3.13-31.

Figure 3.13-2
BHV-1 Radionuclide Concentrations (uCi/ml)



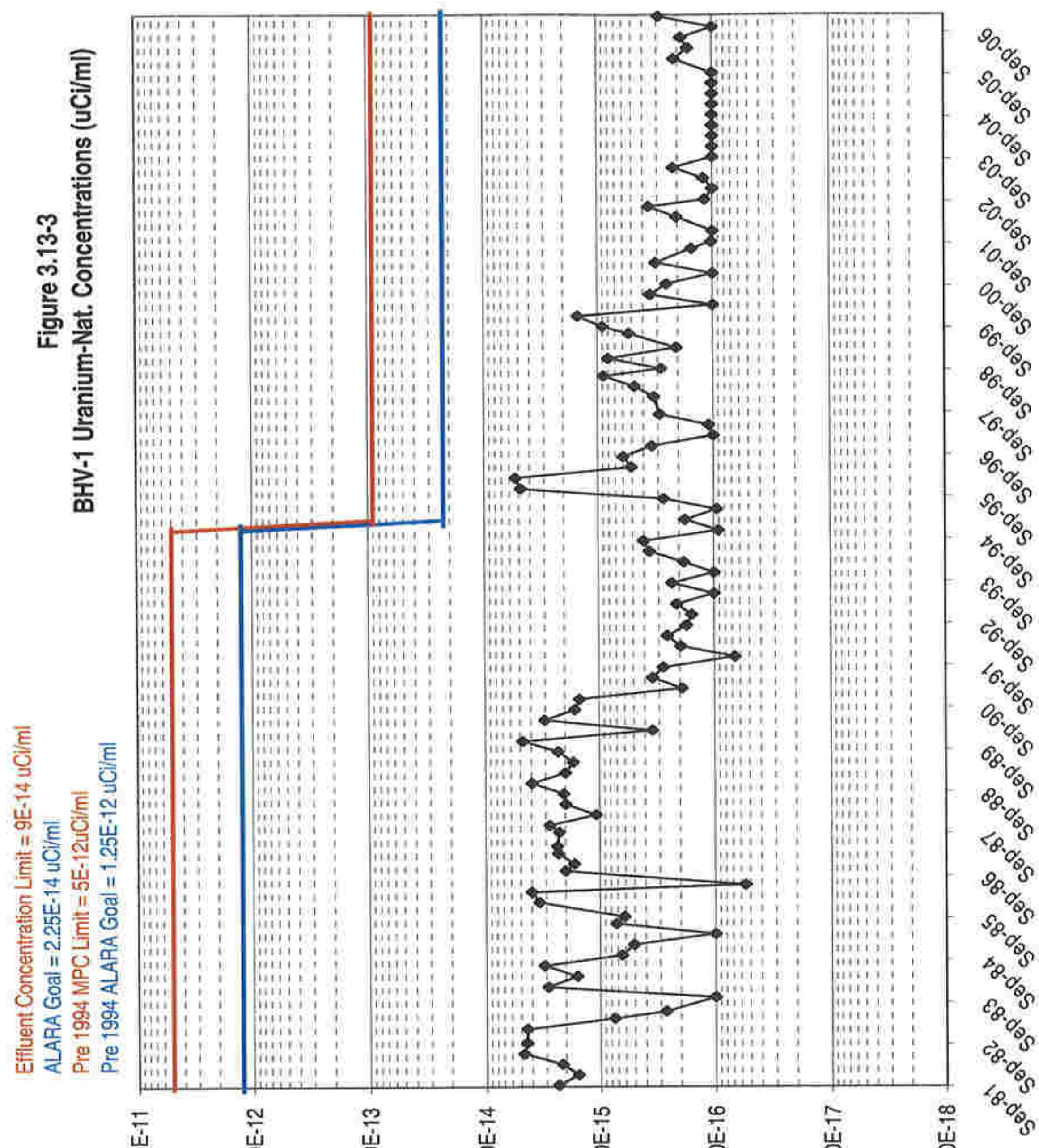


Figure 3.13-3
BHV-1 Uranium-Nat. Concentrations (uCi/ml)

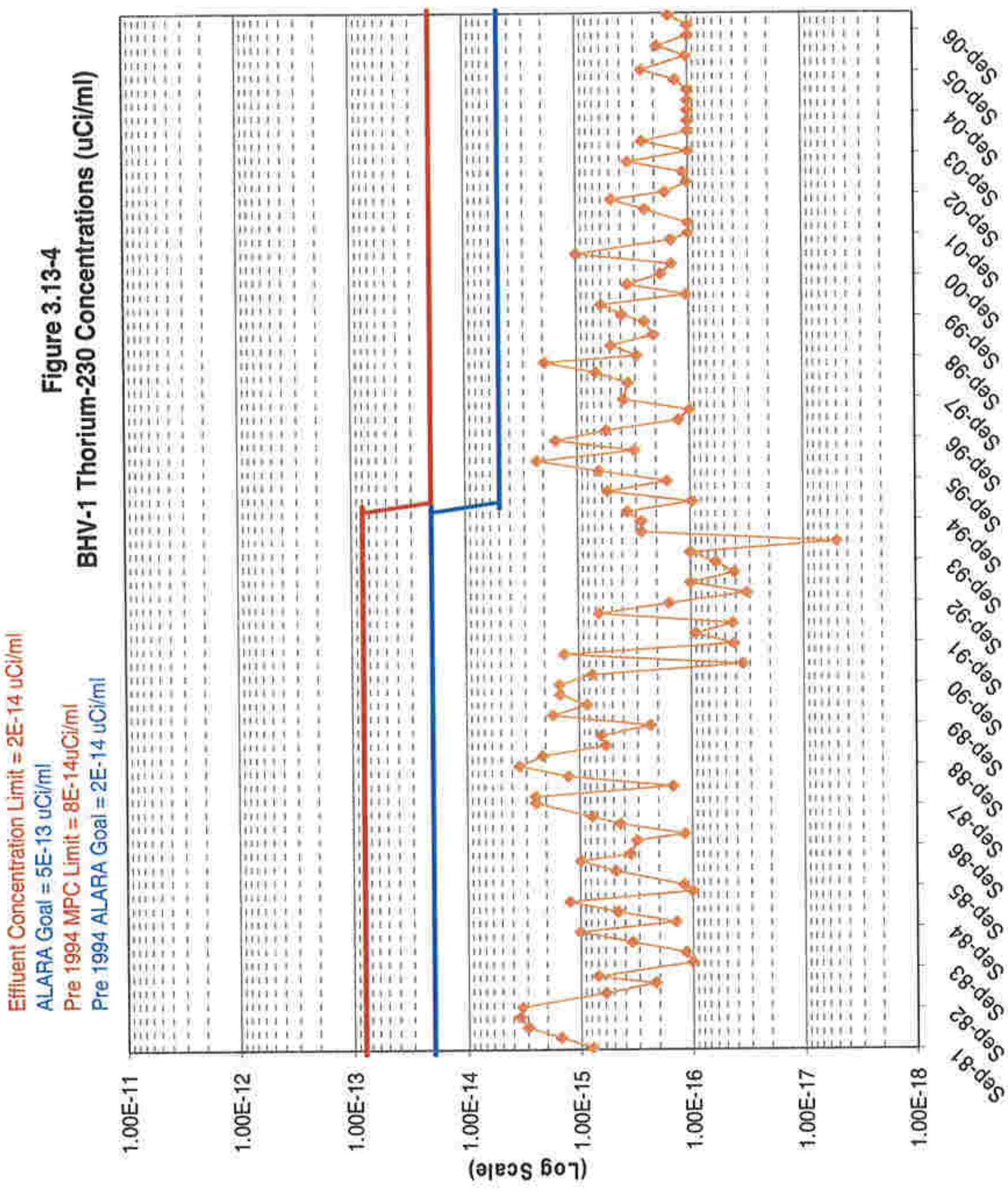


Figure 3.13-4
BHV-1 Thorium-230 Concentrations (uCi/ml)

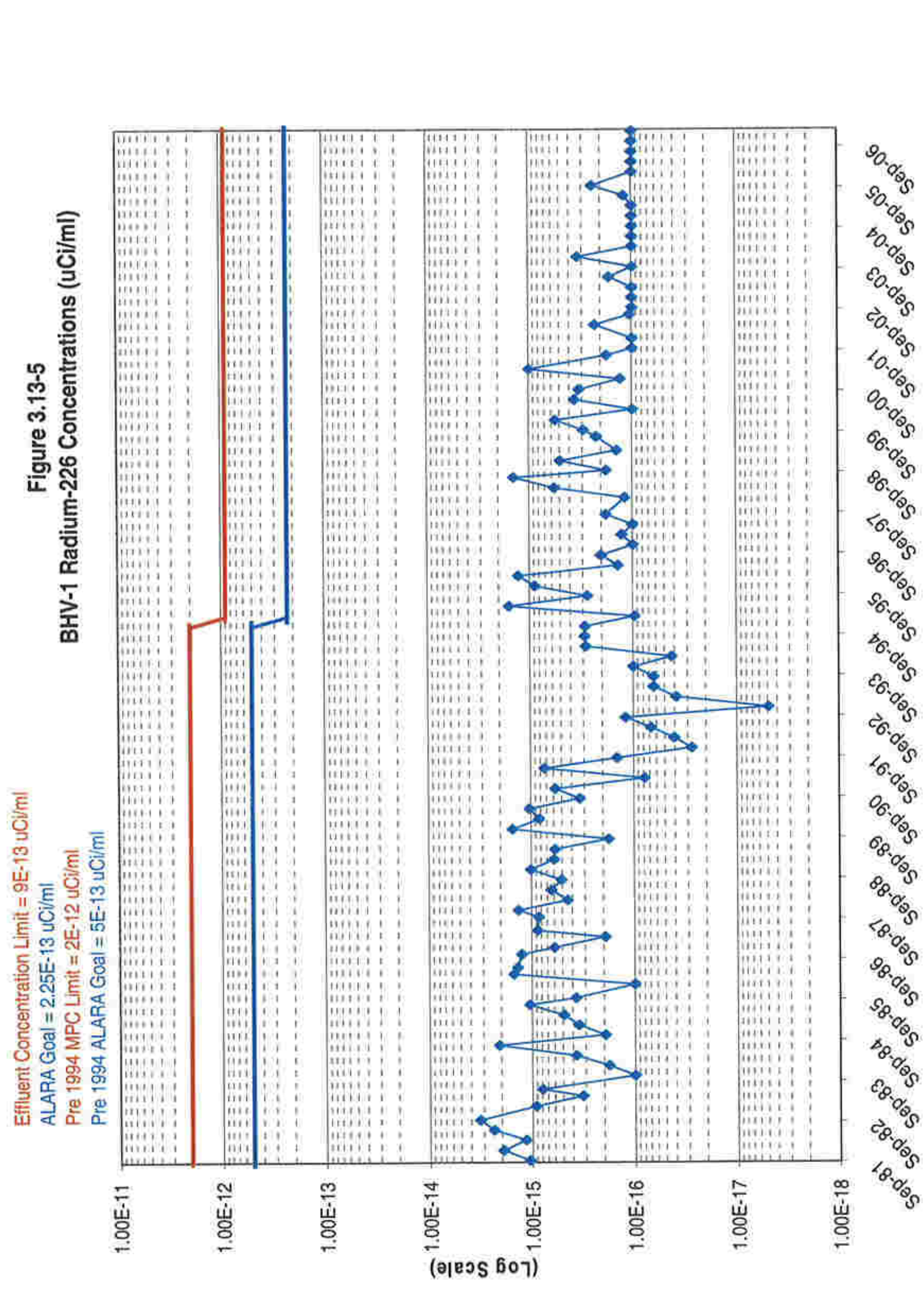


Figure 3.13-5
BHV-1 Radium-226 Concentrations (uCi/ml)

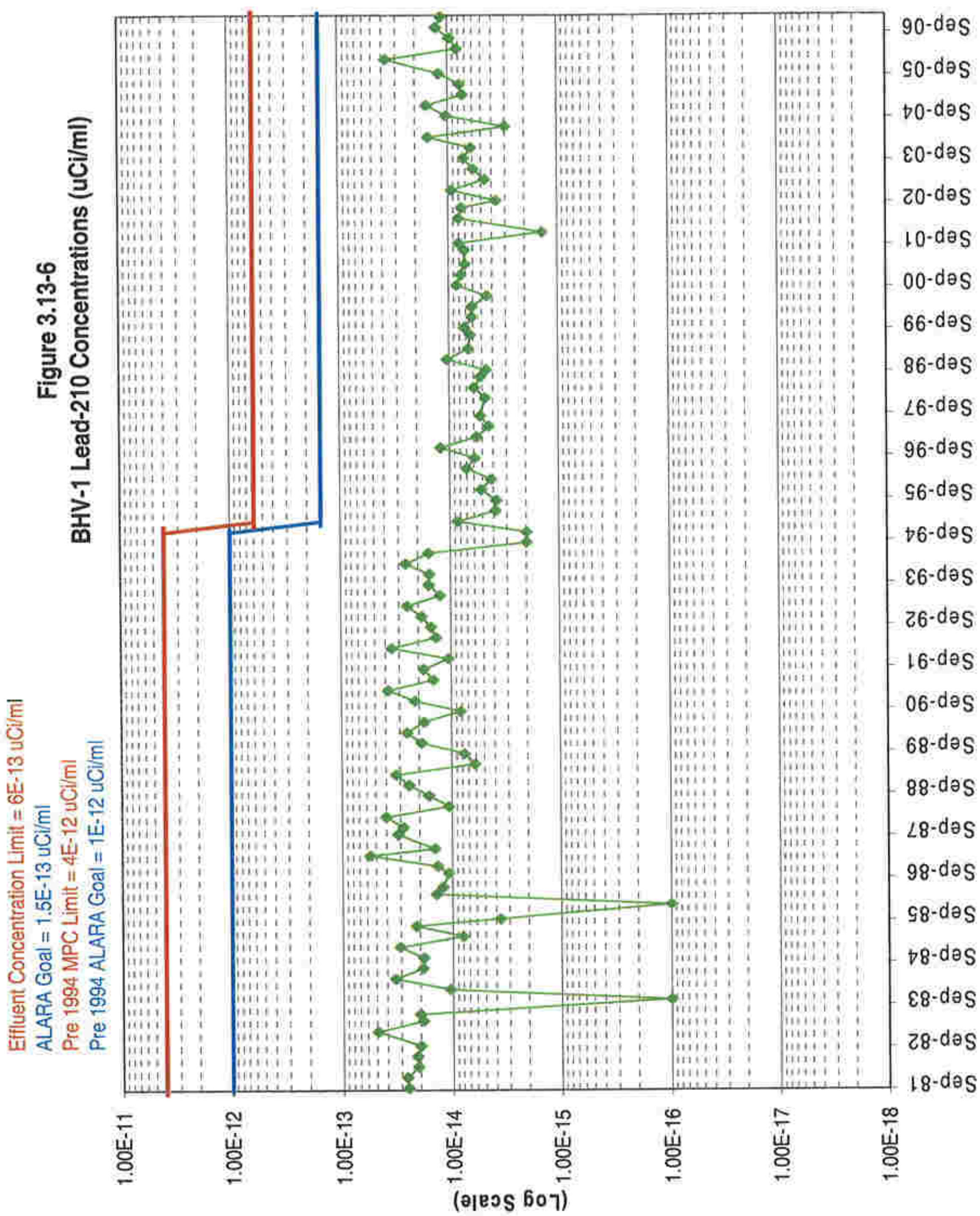
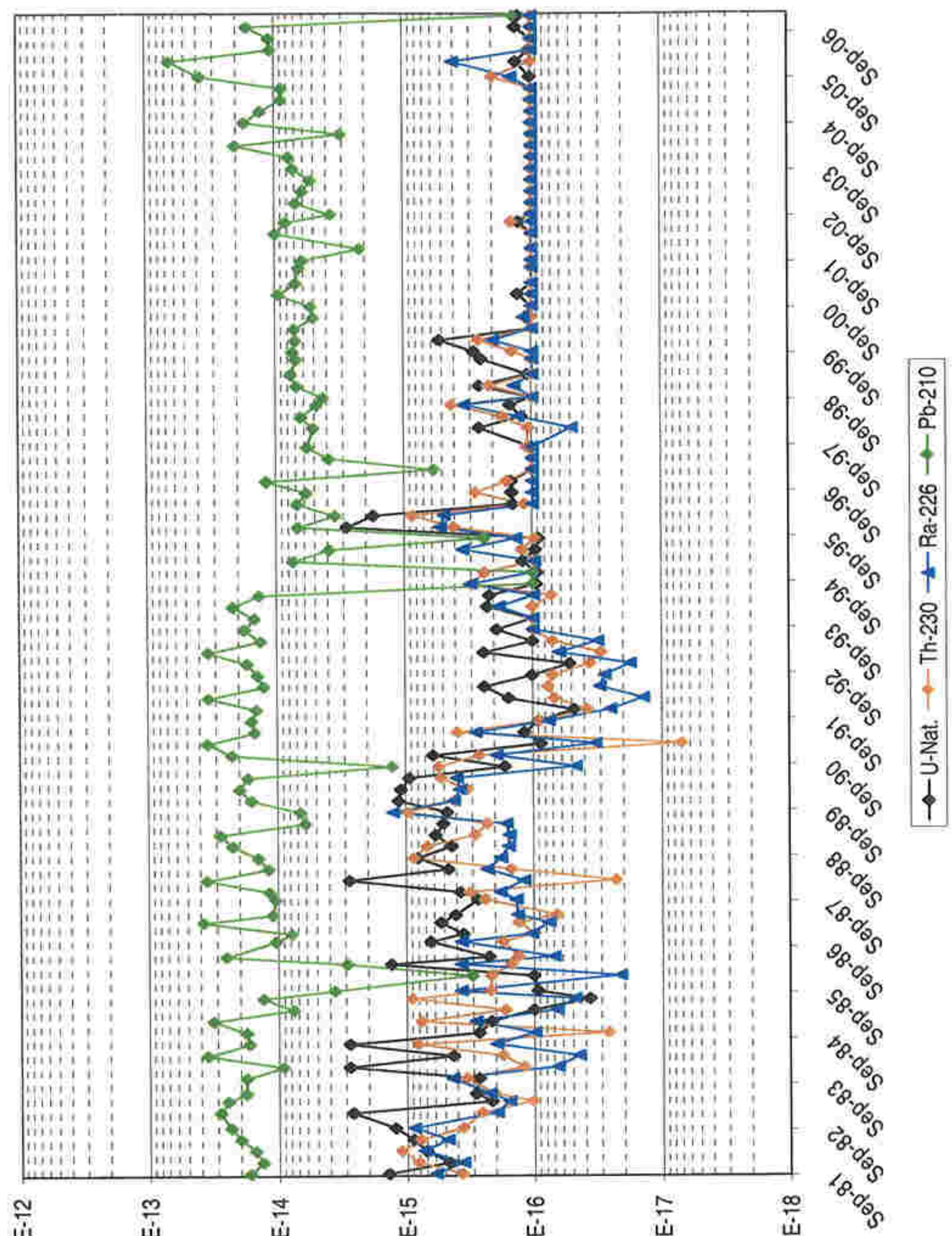


Figure 3.13-6
BHV-1 Lead-210 Concentrations (uCi/ml)

Figure 3.13-7
BHV-2 Radionuclide Concentrations (uCi/ml)



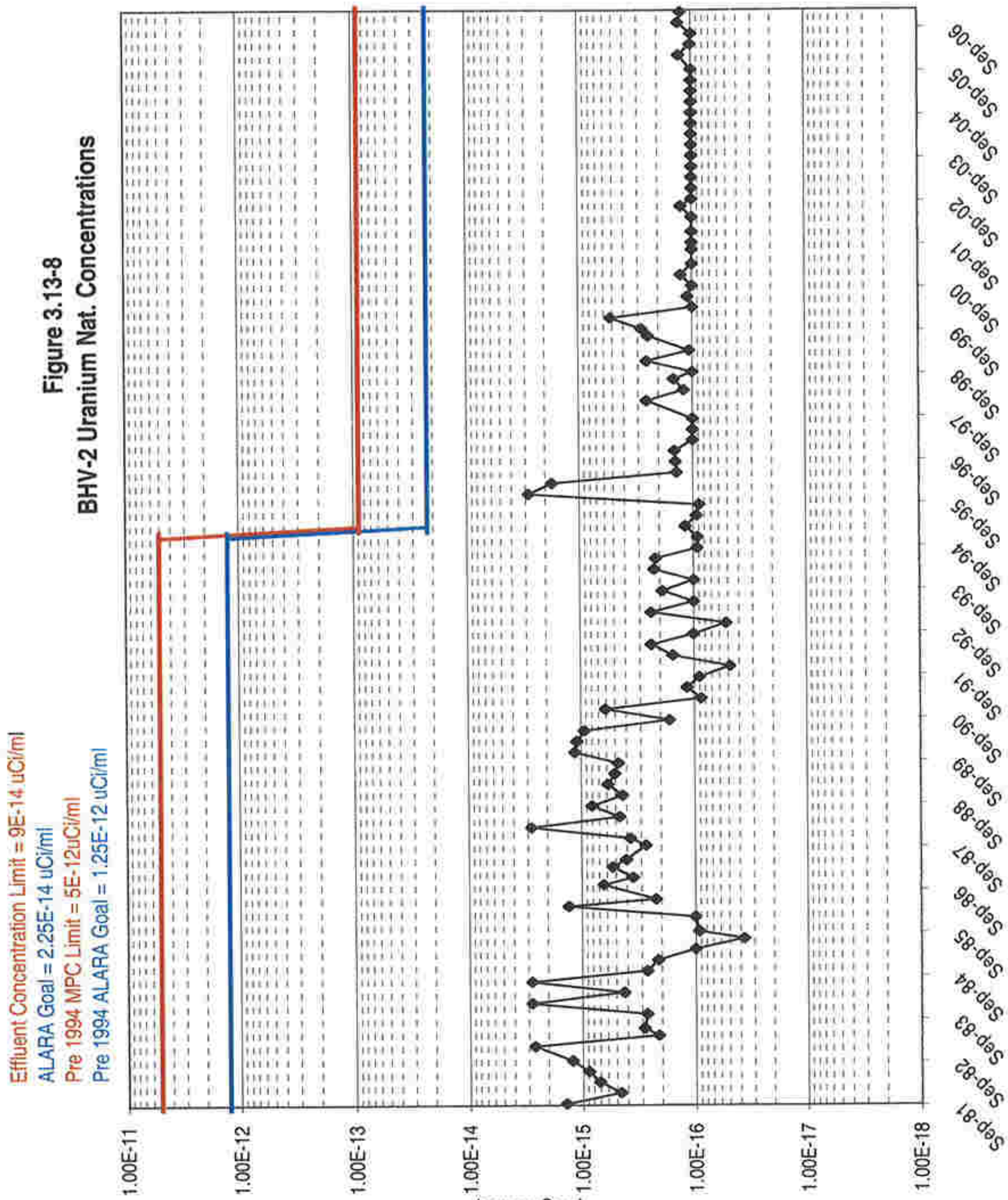


Figure 3.13-8
BHV-2 Uranium Nat. Concentrations
Effluent Concentration Limit = 9E-14 uCi/ml
ALARA Goal = 2.25E-14 uCi/ml
Pre 1994 MPC Limit = 5E-12uCi/ml
Pre 1994 ALARA Goal = 1.25E-12 uCi/ml
(Log Scale)
1.00E-11
1.00E-12
1.00E-13
1.00E-14
1.00E-15
1.00E-16
1.00E-17
1.00E-18
Sep-81
Sep-82
Sep-83
Sep-84
Sep-85
Sep-86
Sep-87
Sep-88
Sep-89
Sep-90
Sep-91
Sep-92
Sep-93
Sep-94
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Sep-04
Sep-05
Sep-06

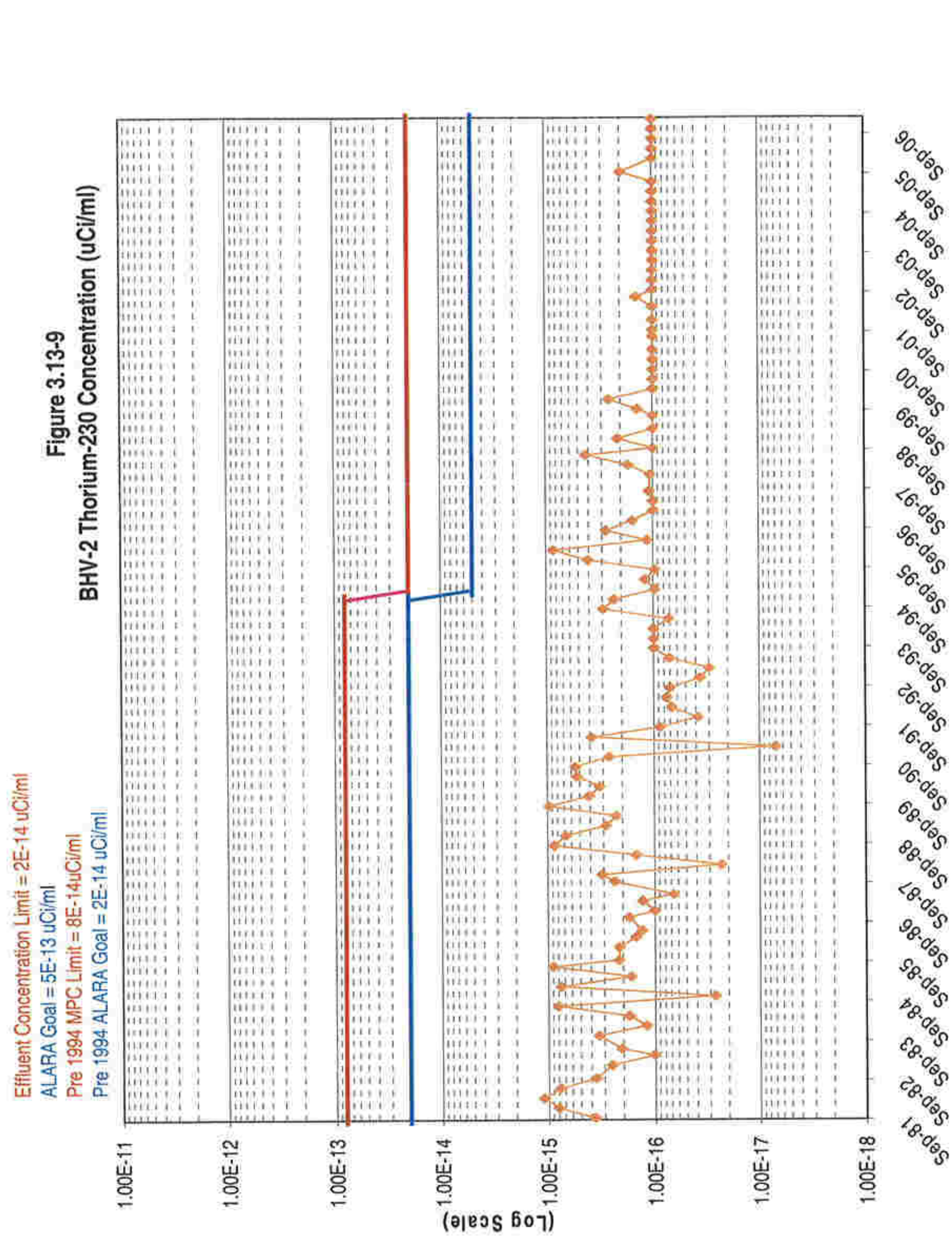

Figure 3.13-9
BHV-2 Thorium-230 Concentration (uCi/ml)

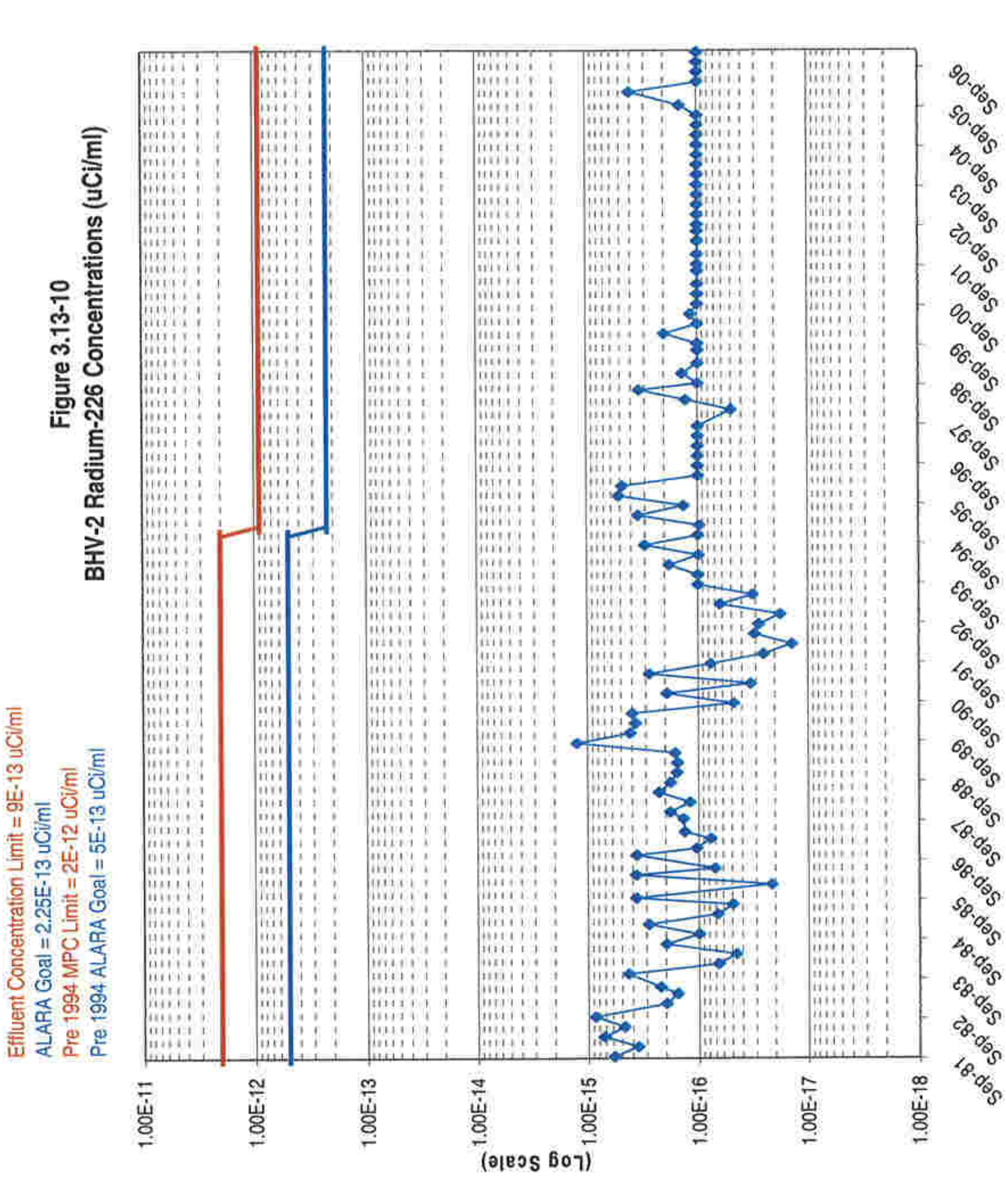

Figure 3.13-10
BHV-2 Radium-226 Concentrations (uCi/ml)
Effluent Concentration Limit = 9E-13 uCi/ml
ALARA Goal = 2.25E-13 uCi/ml
Pre 1994 MPC Limit = 2E-12 uCi/ml
Pre 1994 ALARA Goal = 5E-13 uCi/ml
(Log Scale)
1.00E-11
1.00E-12
1.00E-13
1.00E-14
1.00E-15
1.00E-16
1.00E-17
1.00E-18
Sep-81
Sep-82
Sep-83
Sep-84
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Sep-04
Sep-05
Sep-06

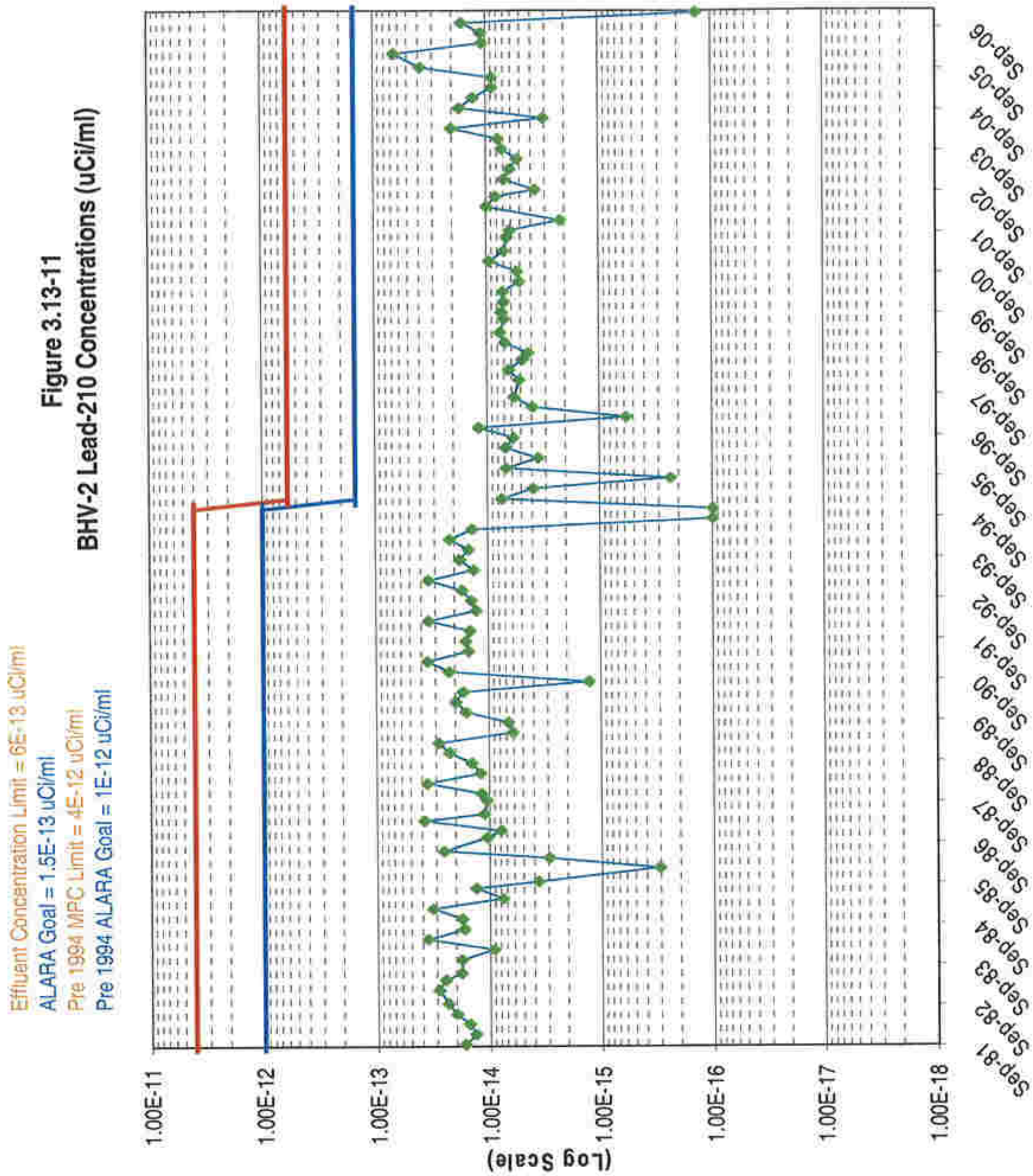


Figure 3.13-11
BHV-2 Lead-210 Concentrations (uCi/ml)

Figure 3.13-12
BHV-3 Radionuclide Concentrations (uCi/ml)

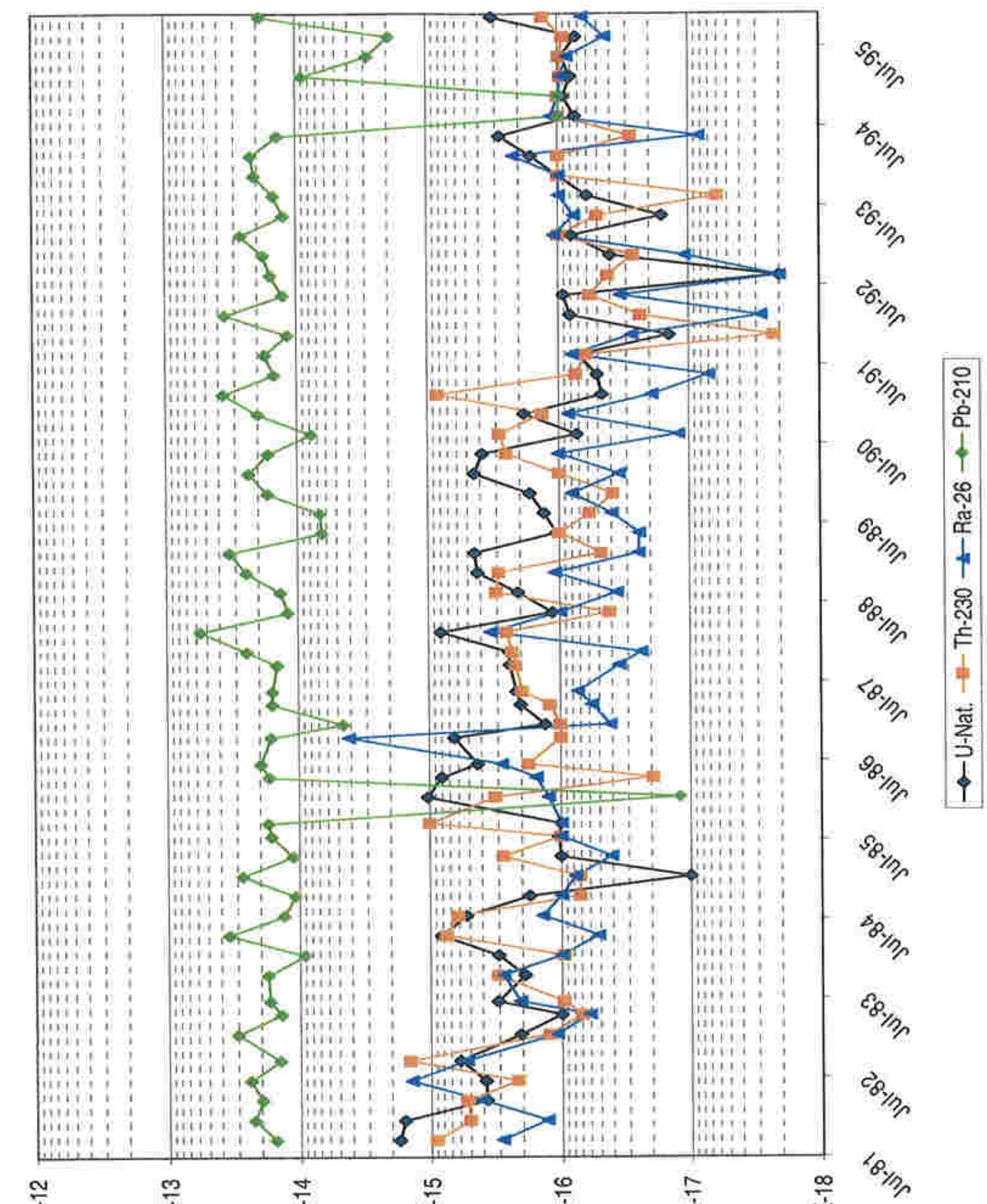
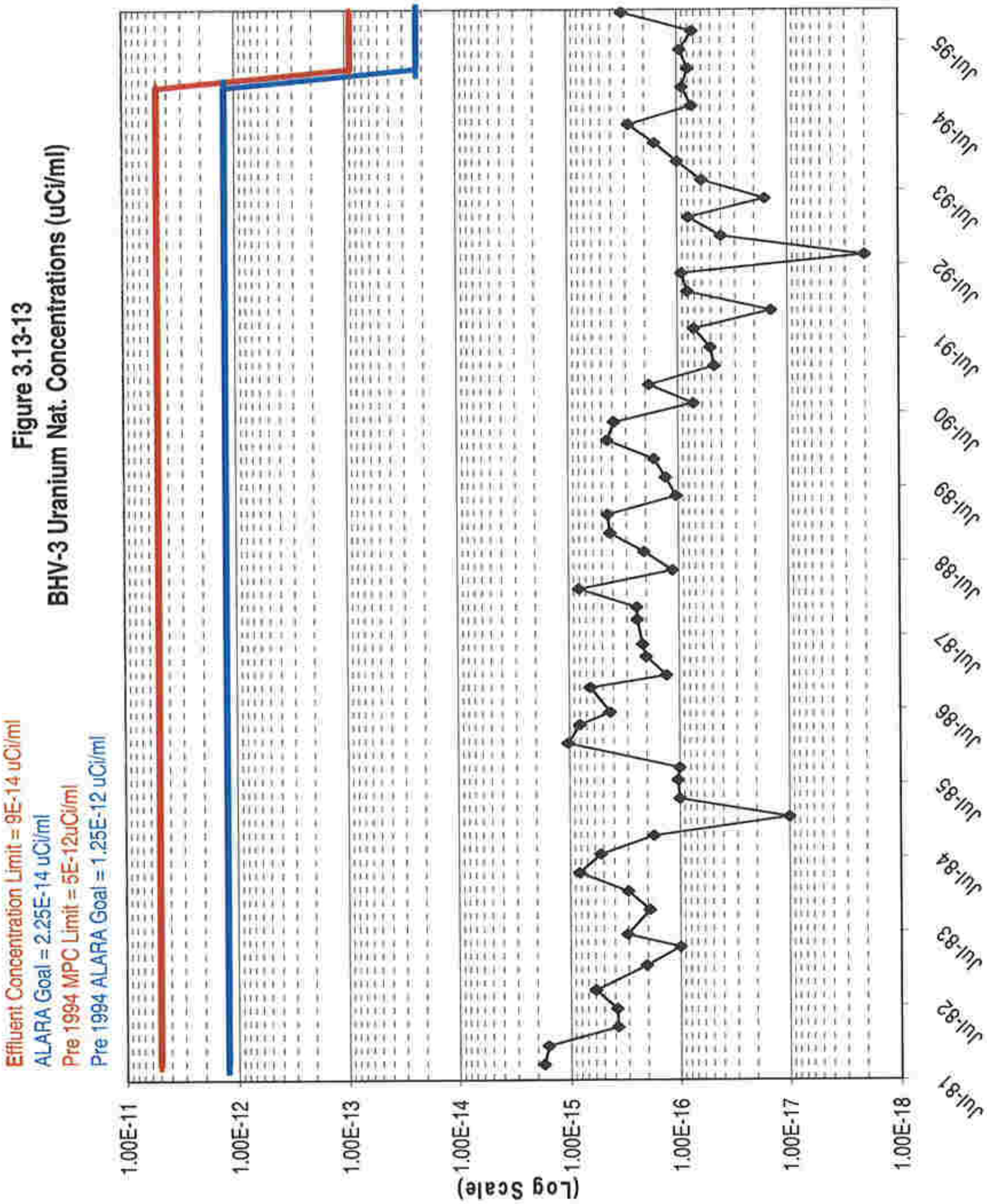


Figure 3.13-13
BHV-3 Uranium Nat. Concentrations (uCi/ml)



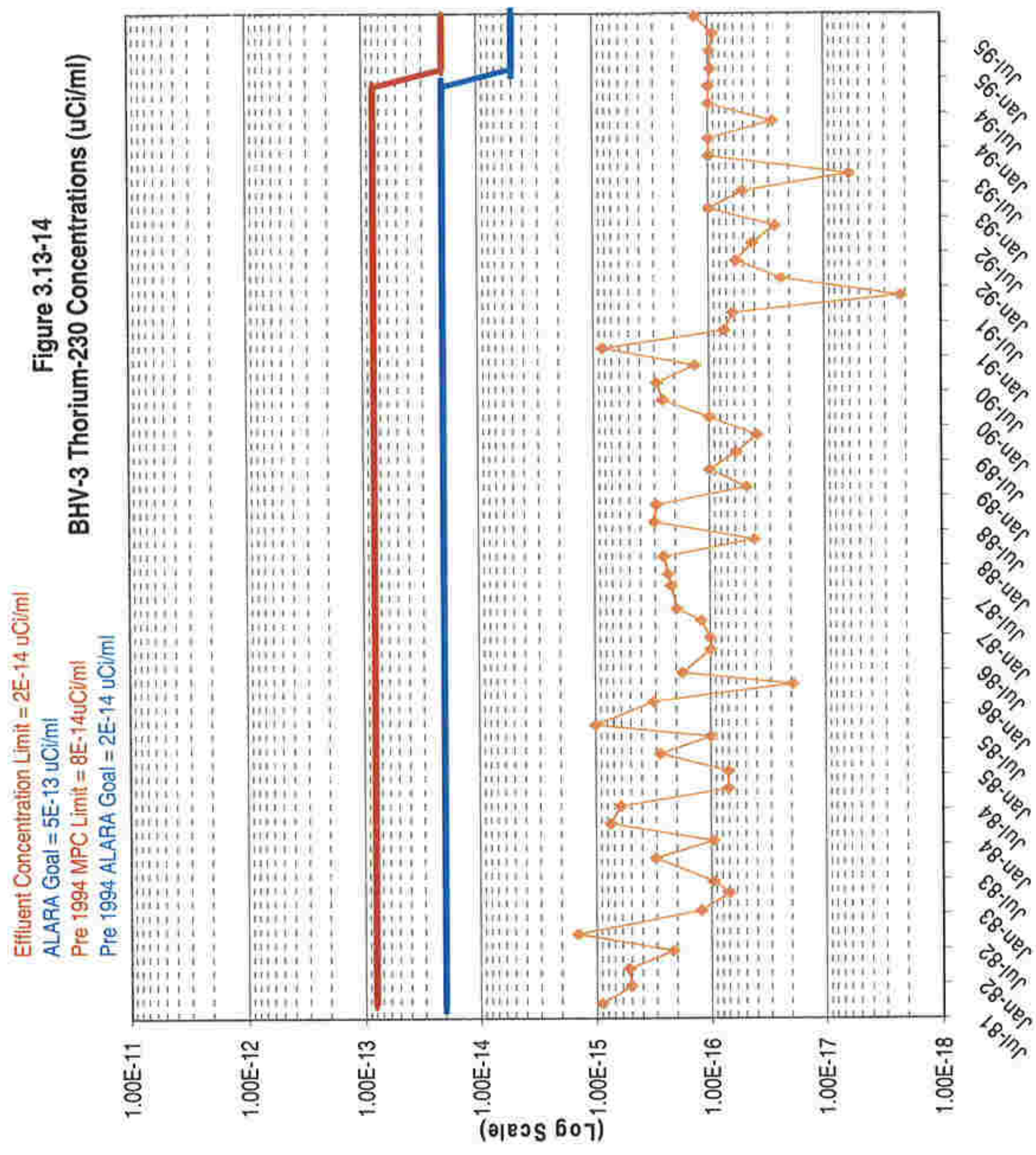


Figure 3.13-14
BHV-3 Thorium-230 Concentrations (uCi/ml)

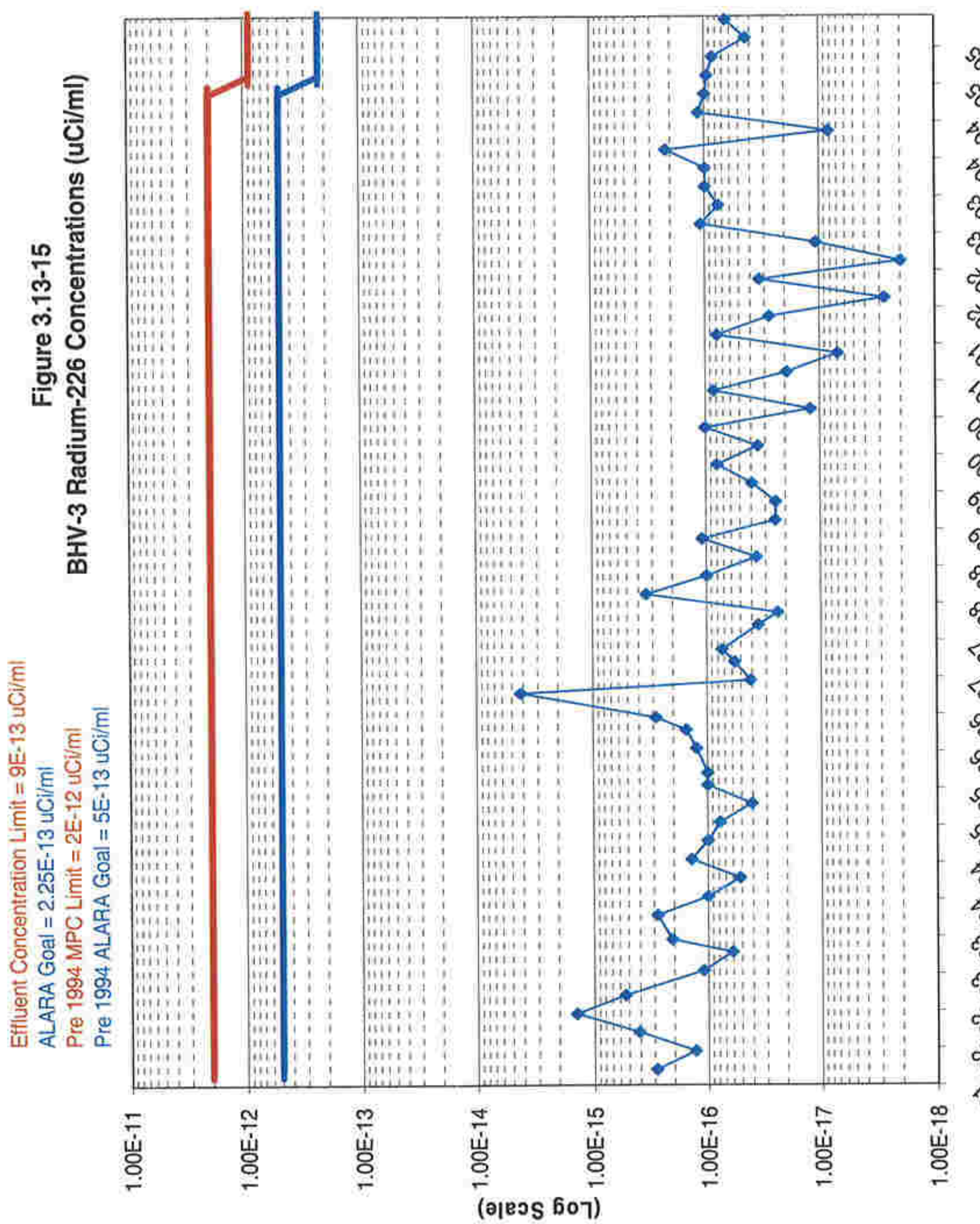


Figure 3.13-15
BHV-3 Radium-226 Concentrations (uCi/ml)

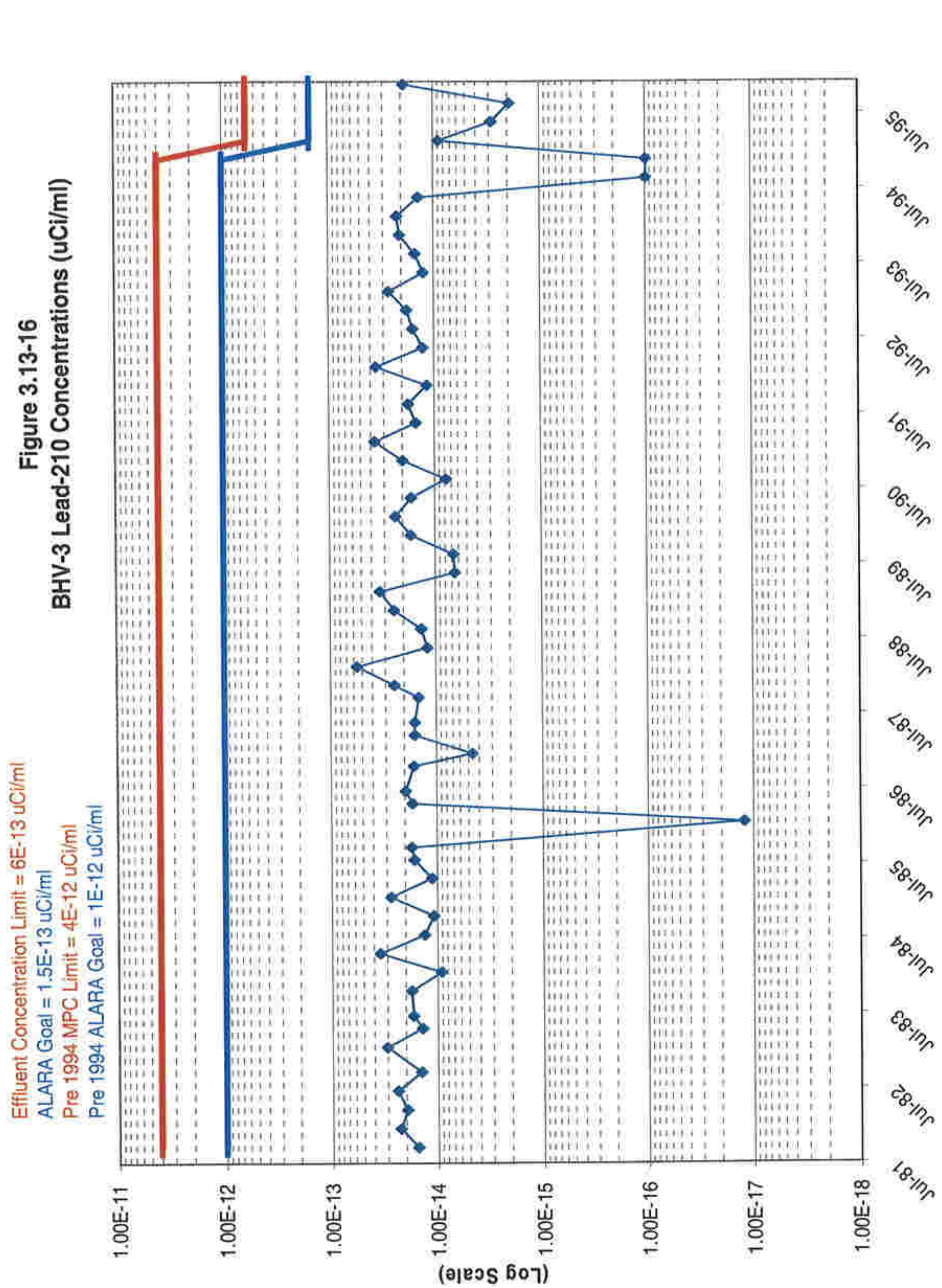
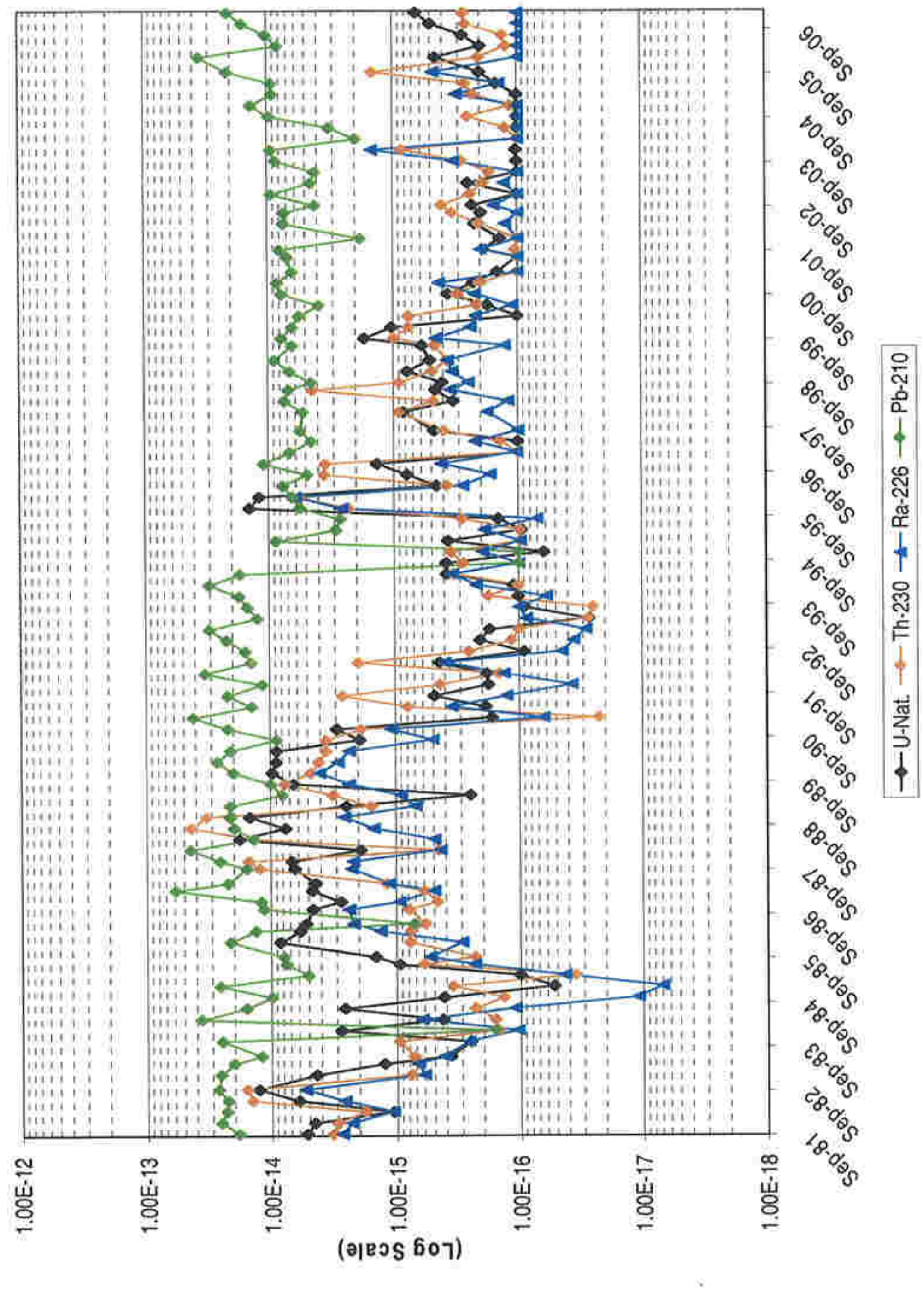


Figure 3.13-16
BHV-3 Lead-210 Concentrations (uCi/ml)

Figure 3.13-17
BHV-4 Radionuclide Concentrations (uCi/ml)



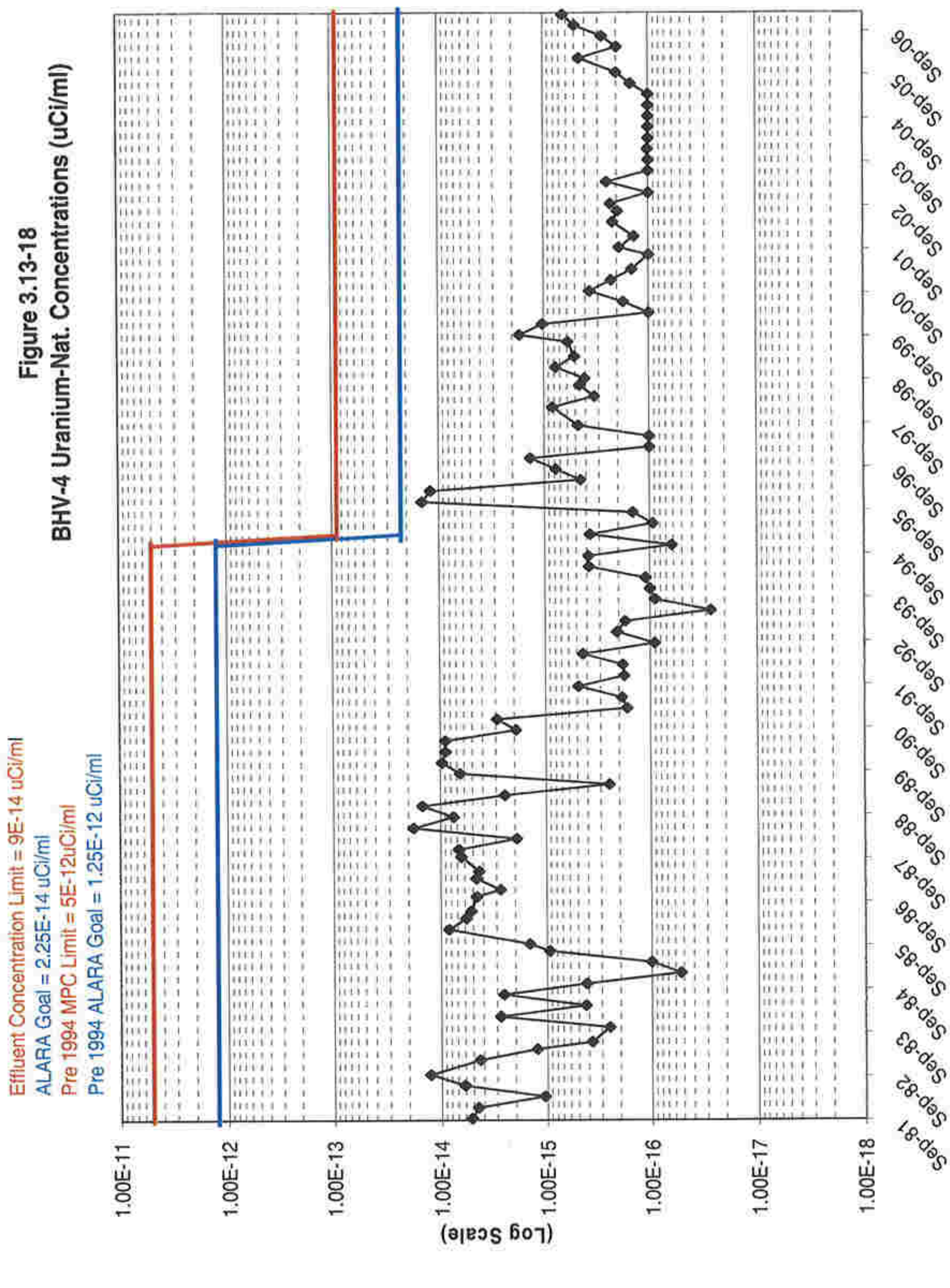


Figure 3.13-18
BHV-4 Uranium-Nat. Concentrations (uCi/ml)
Effluent Concentration Limit = 9E-14 uCi/ml
ALARA Goal = 2.25E-14 uCi/ml
Pre 1994 MPC Limit = 5E-12uCi/ml
Pre 1994 ALARA Goal = 1.25E-12 uCi/ml
(Log Scale)
1.00E-11
1.00E-12
1.00E-13
1.00E-14
1.00E-15
1.00E-16
1.00E-17
1.00E-18
Sep-81
Sep-82
Sep-83
Sep-84
Sep-85
Sep-86
Sep-87
Sep-88
Sep-89
Sep-90
Sep-91
Sep-92
Sep-93
Sep-94
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Sep-02
Sep-03
Sep-04
Sep-05
Sep-06

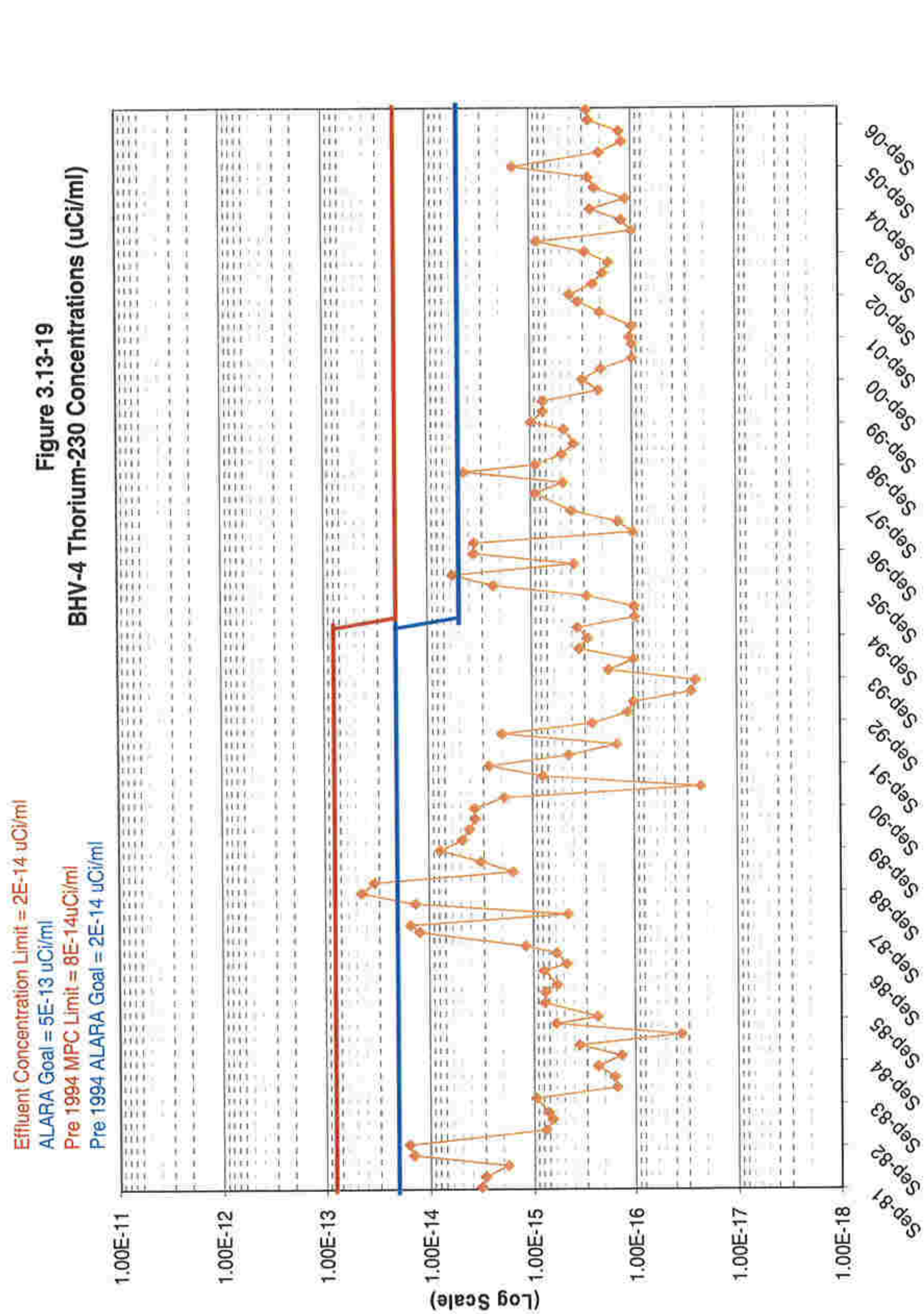


Figure 3.13-19
BHV-4 Thorium-230 Concentrations (uCi/ml)

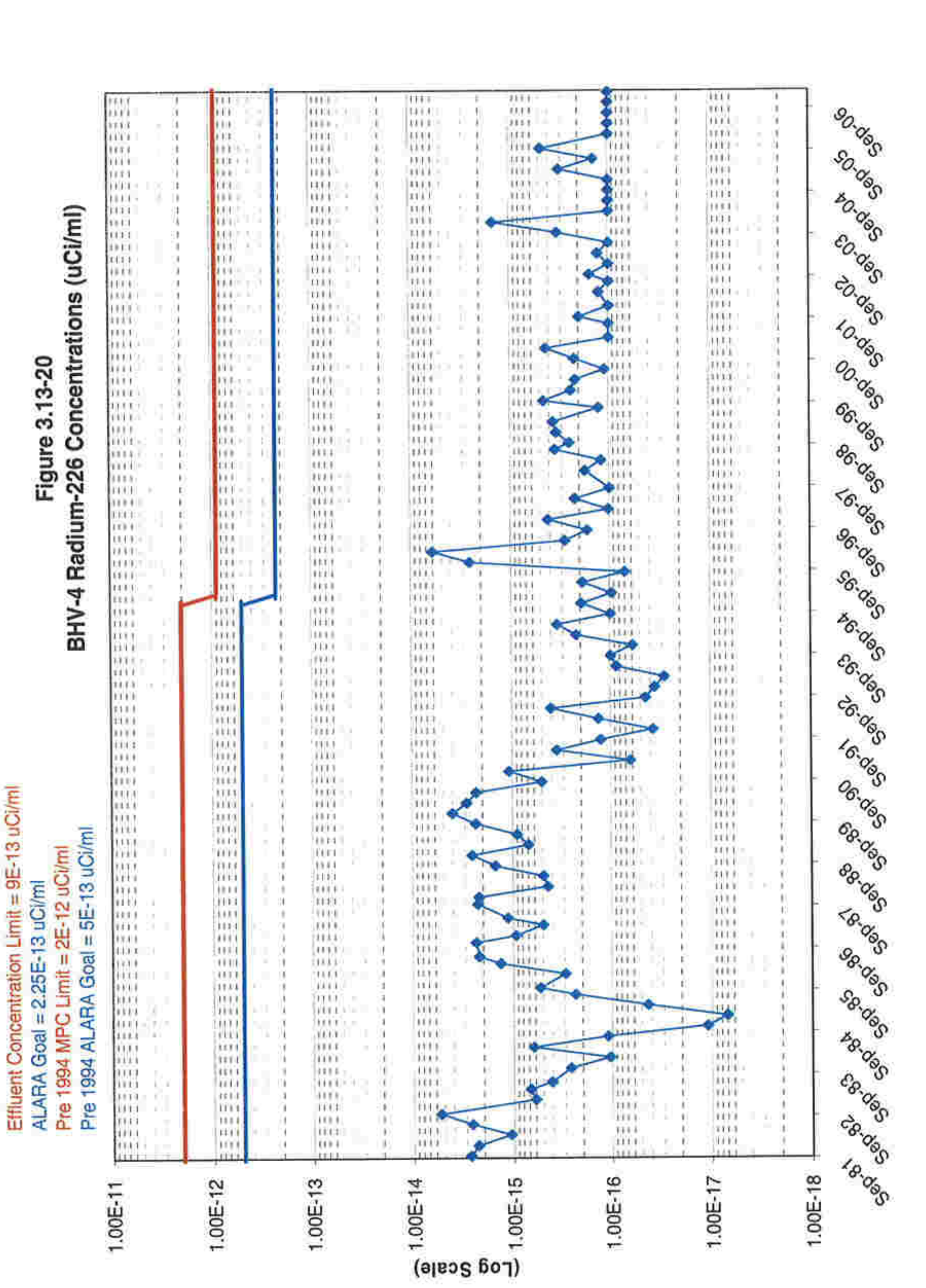


Figure 3.13-20
BHV-4 Radium-226 Concentrations (uCi/ml)

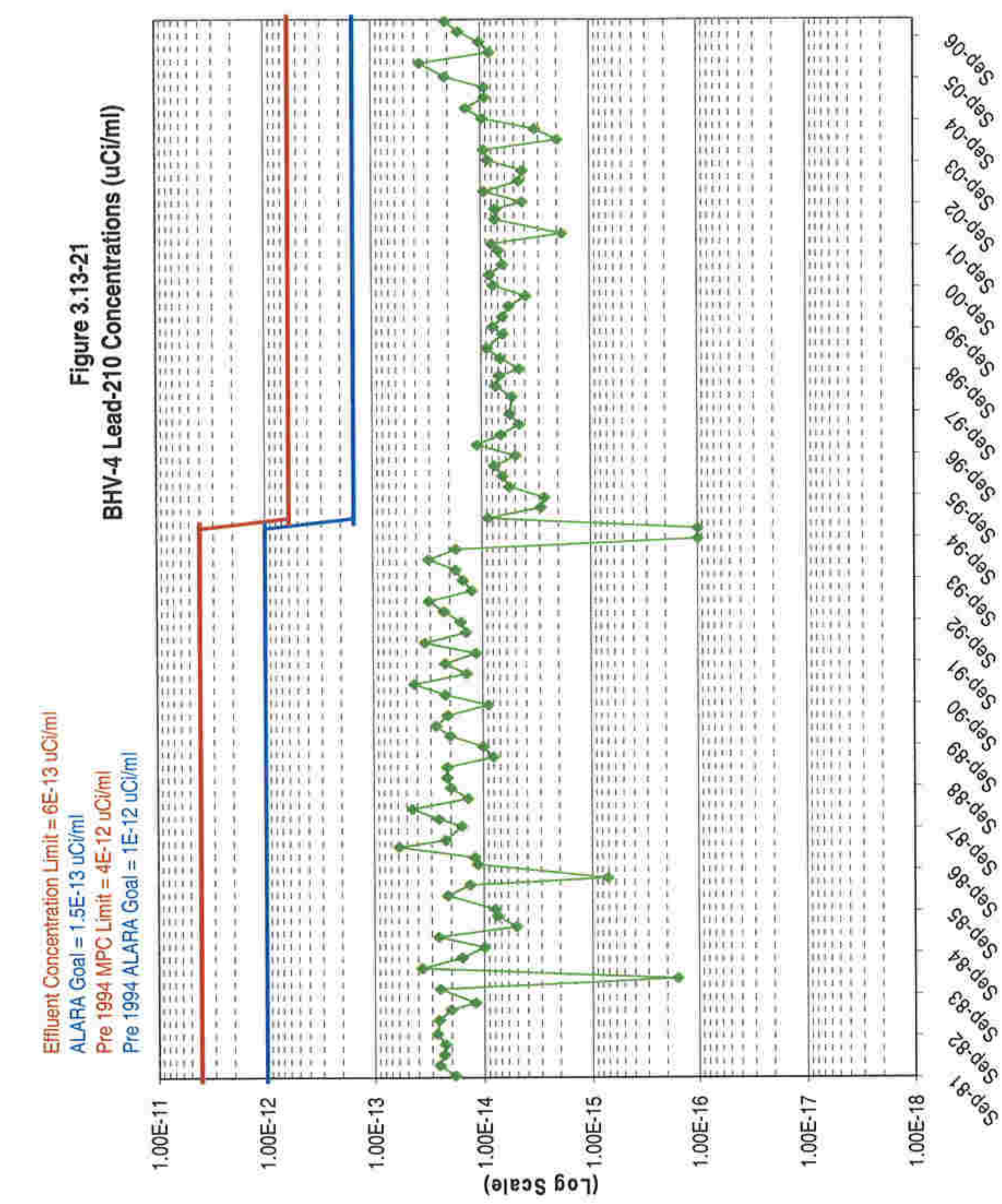
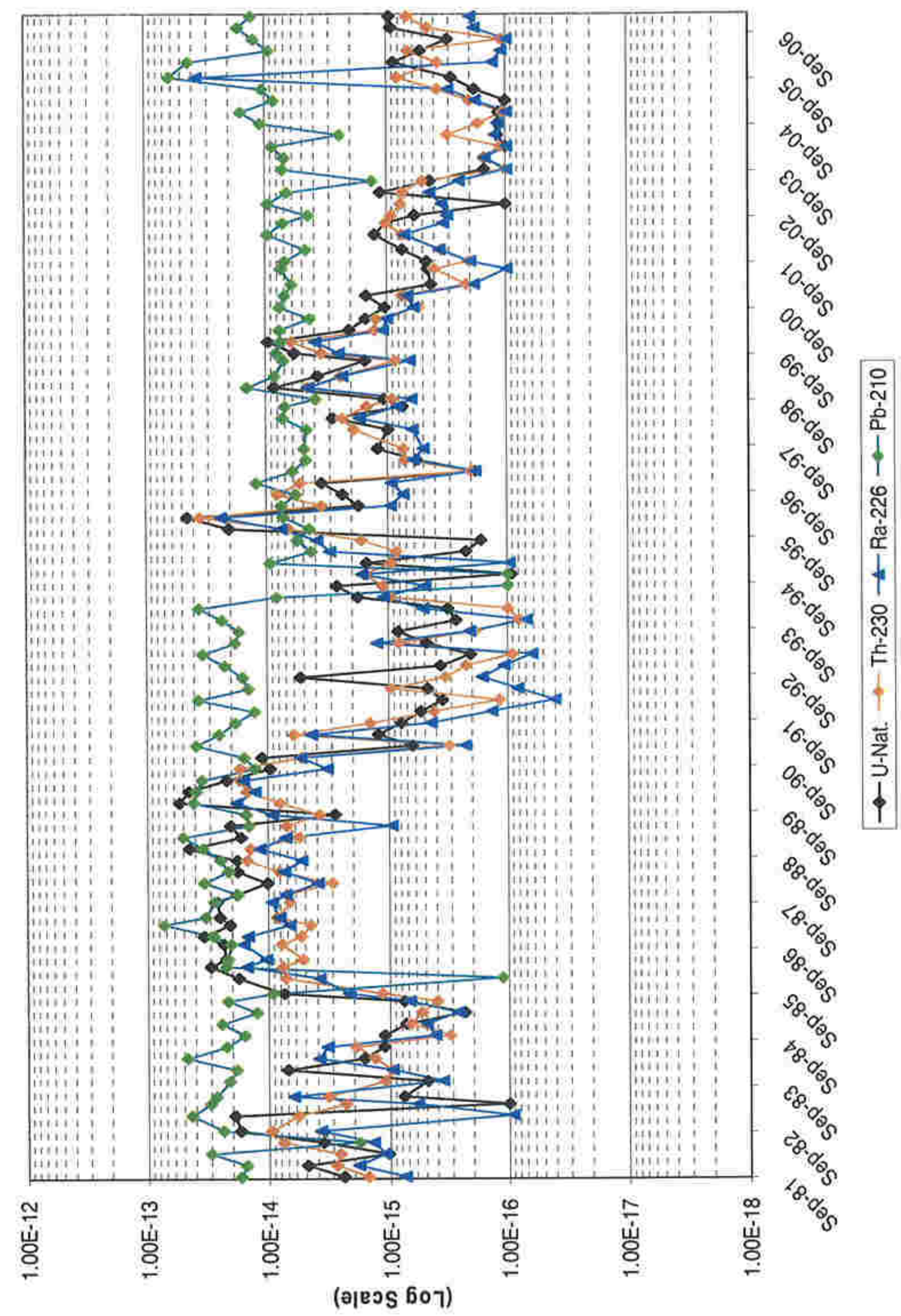


Figure 3.13-21
BHV-4 Lead-210 Concentrations (uCi/ml)

Figure 3.13-22
BHV-5 Radionuclide Concentrations (uCi/ml)



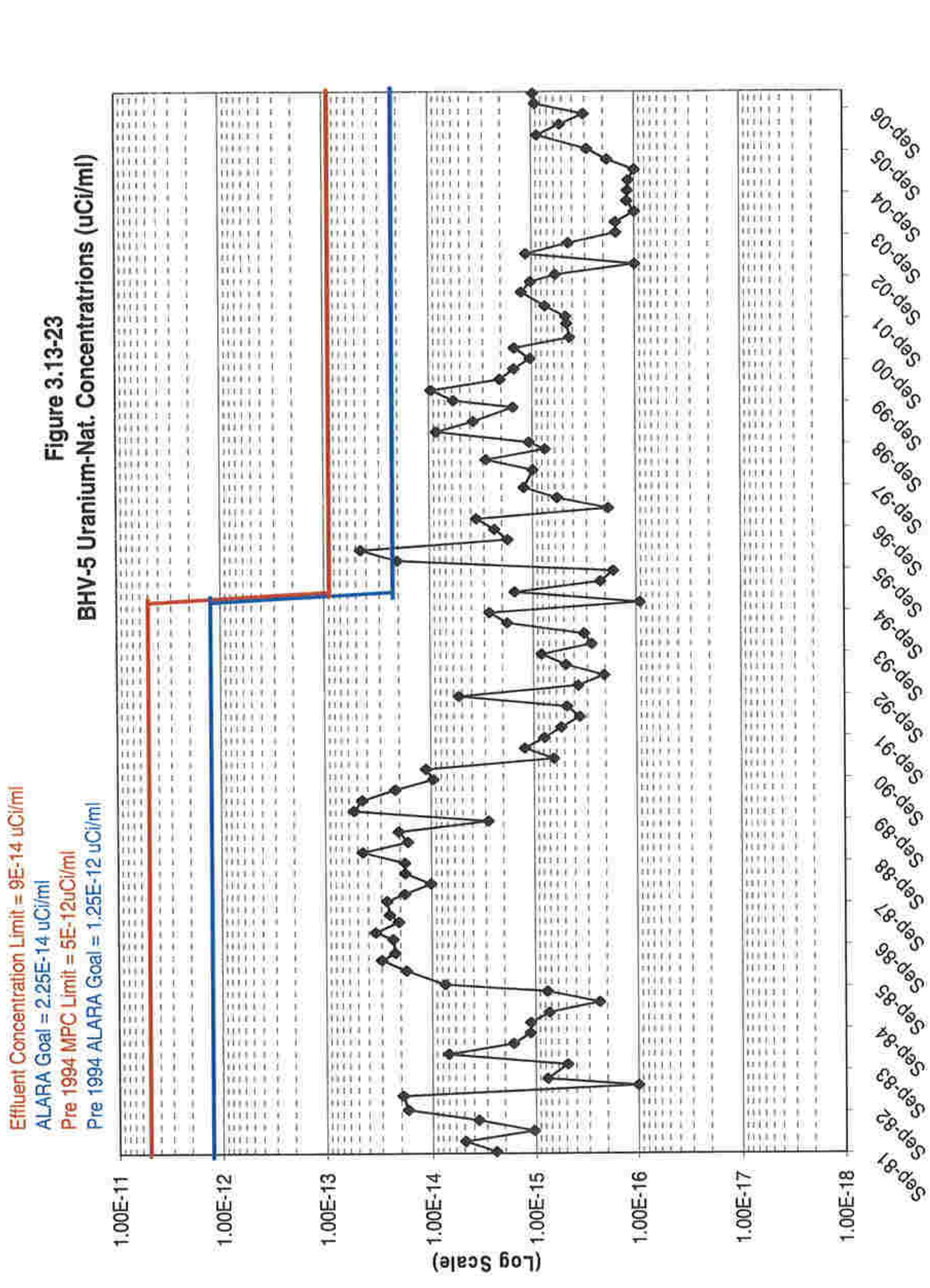


Figure 3.13-23
BHV-5 Uranium-Nat. Concentratrions (uCi/ml)

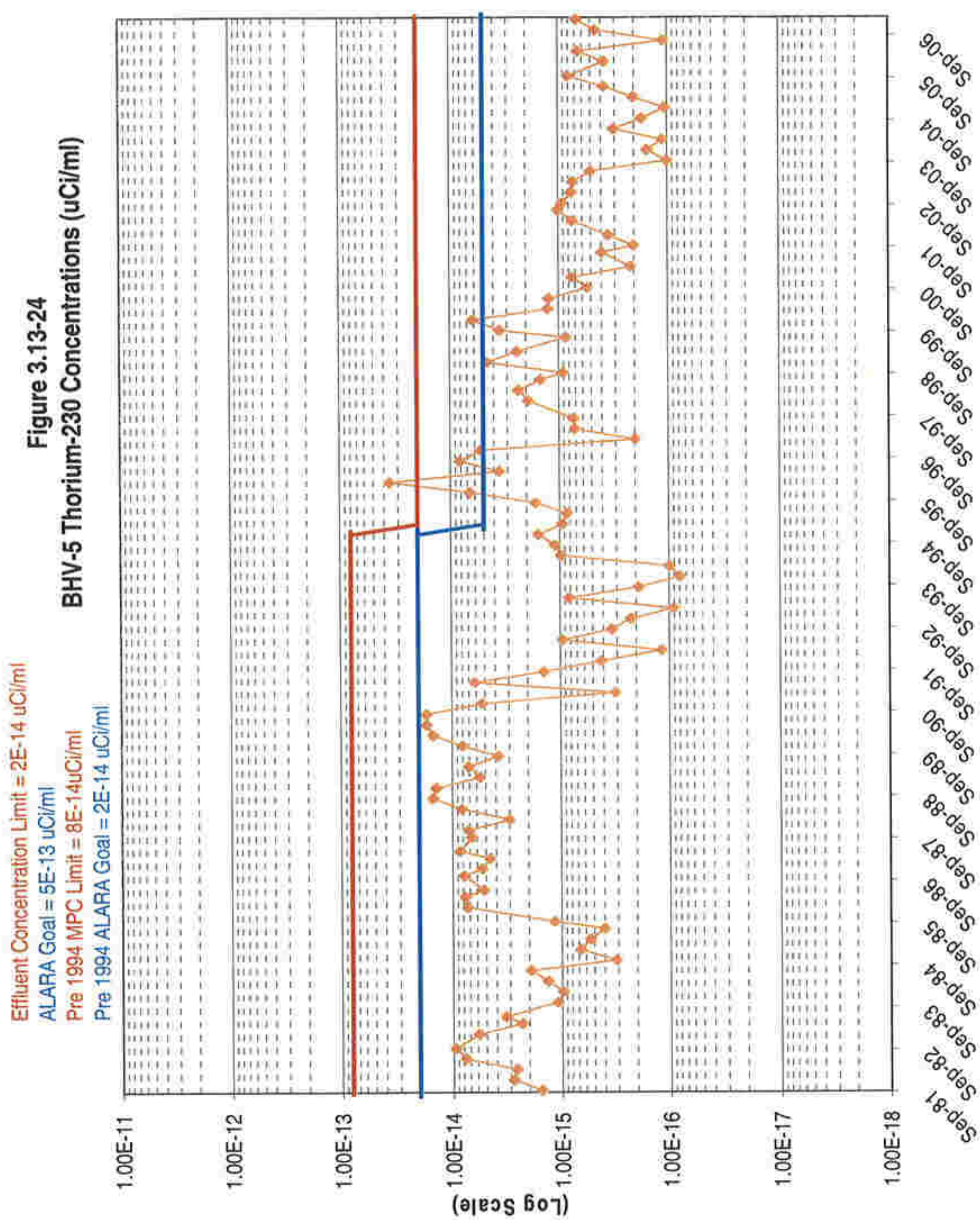


Figure 3.13-24
BHV-5 Thorium-230 Concentrations (uCi/ml)

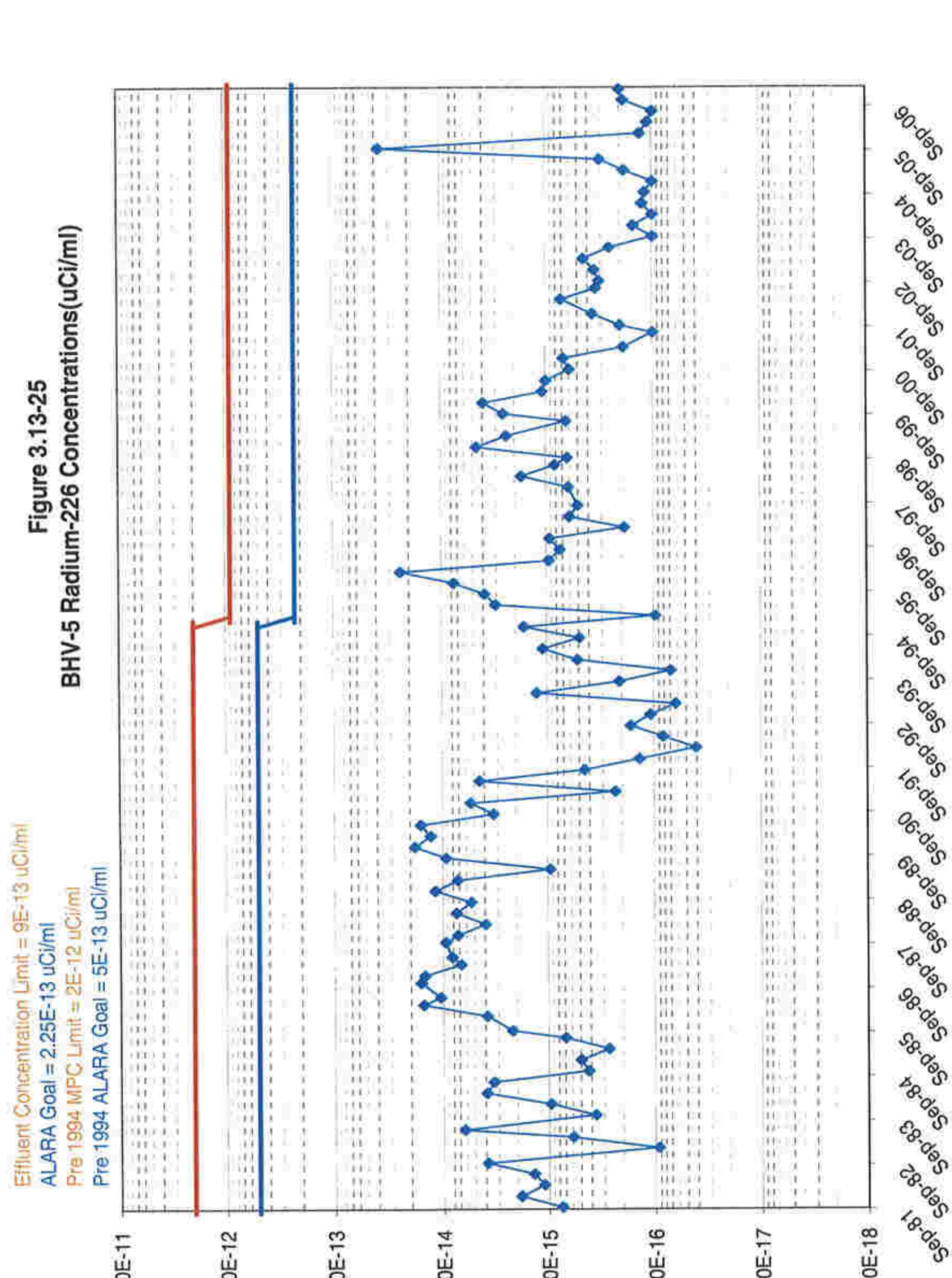


Figure 3.13-25
BHV-5 Radium-226 Concentrations(uCi/ml)

Figure 3.13-26
BHV-5 Lead-210 Concentrations (uCi/ml)

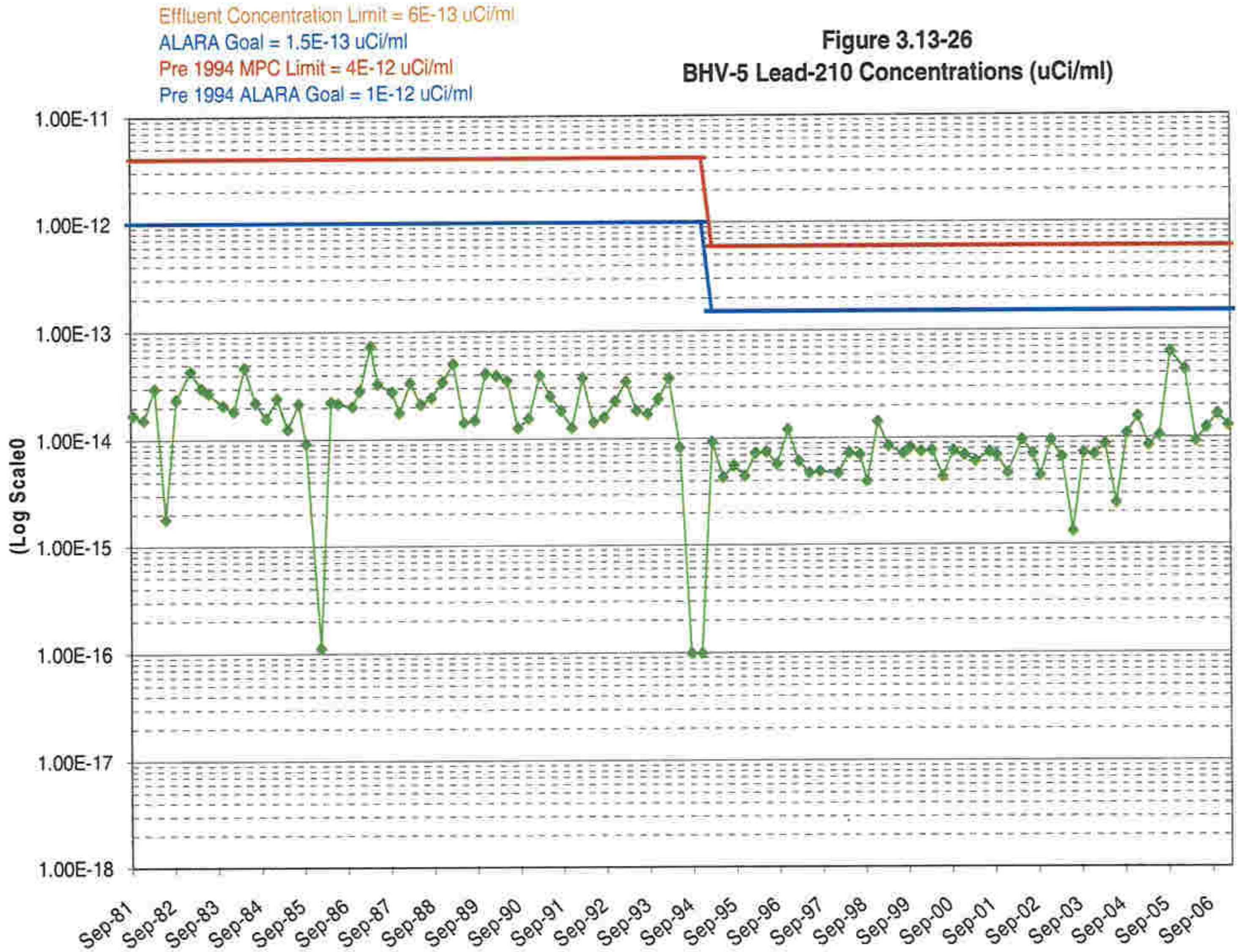
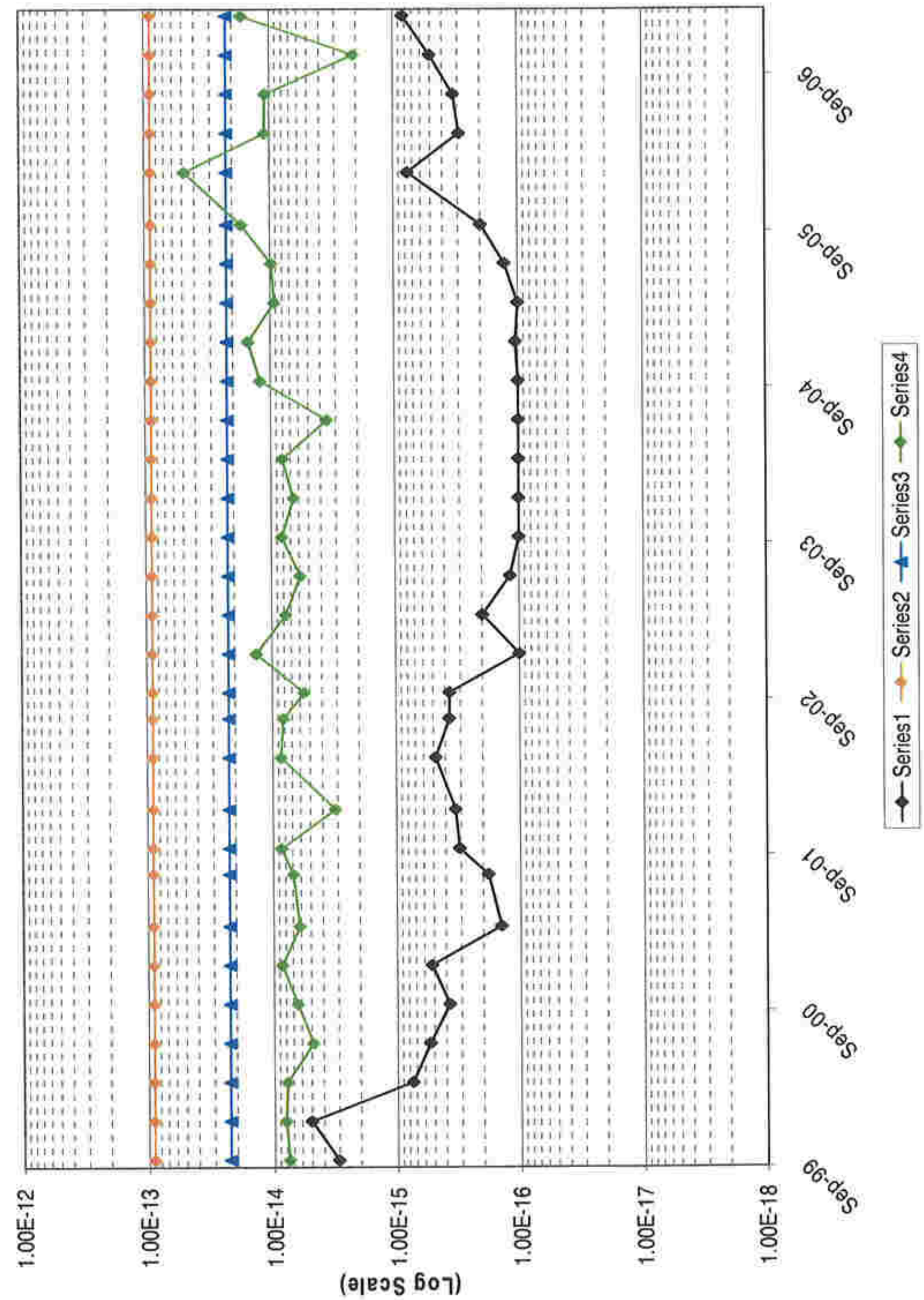


Figure 3.13-27
BHV-6 Radionuclide Concentrations (uCi/ml)



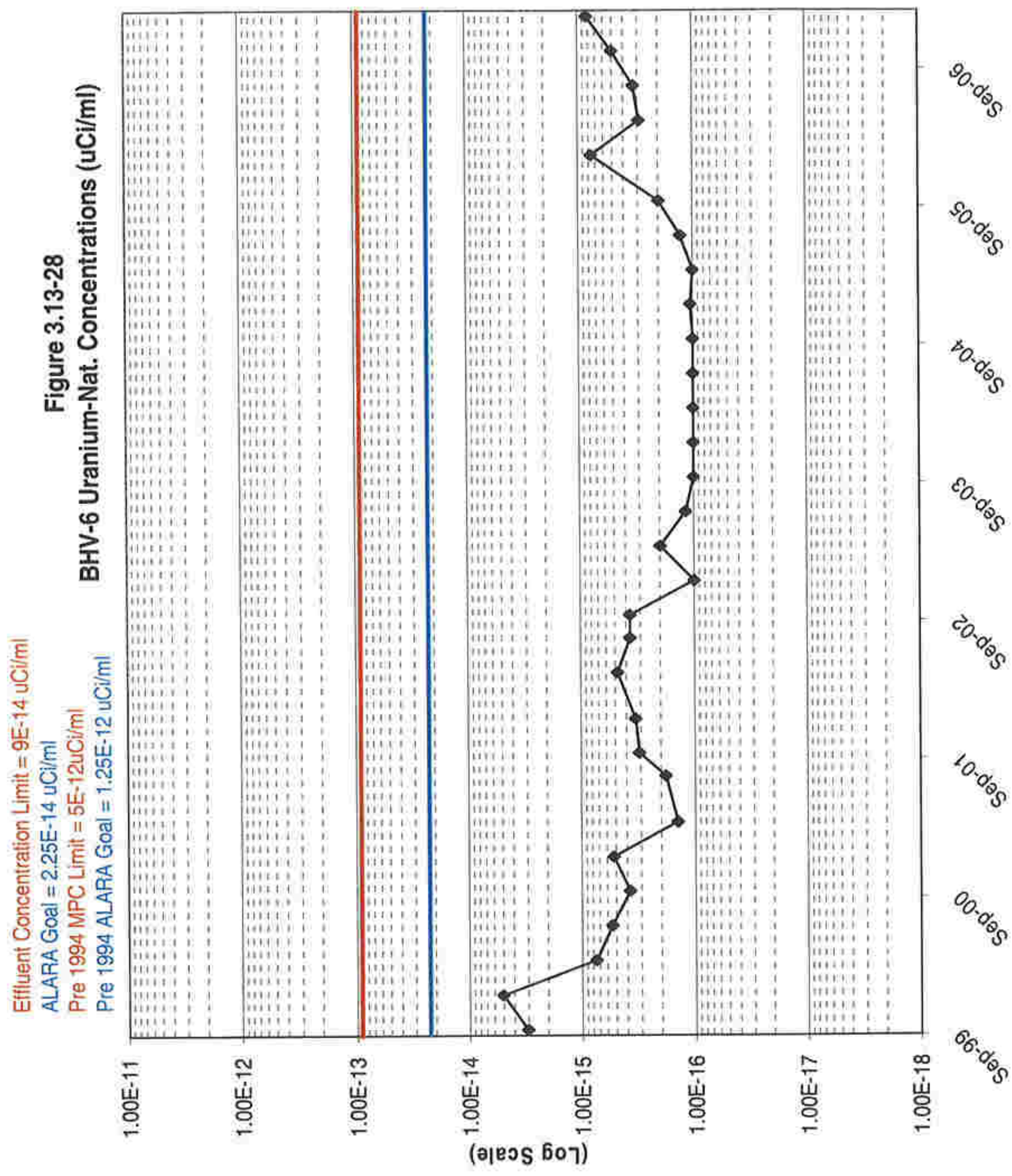


Figure 3.13-28
BHV-6 Uranium-Nat. Concentrations (uCi/ml)

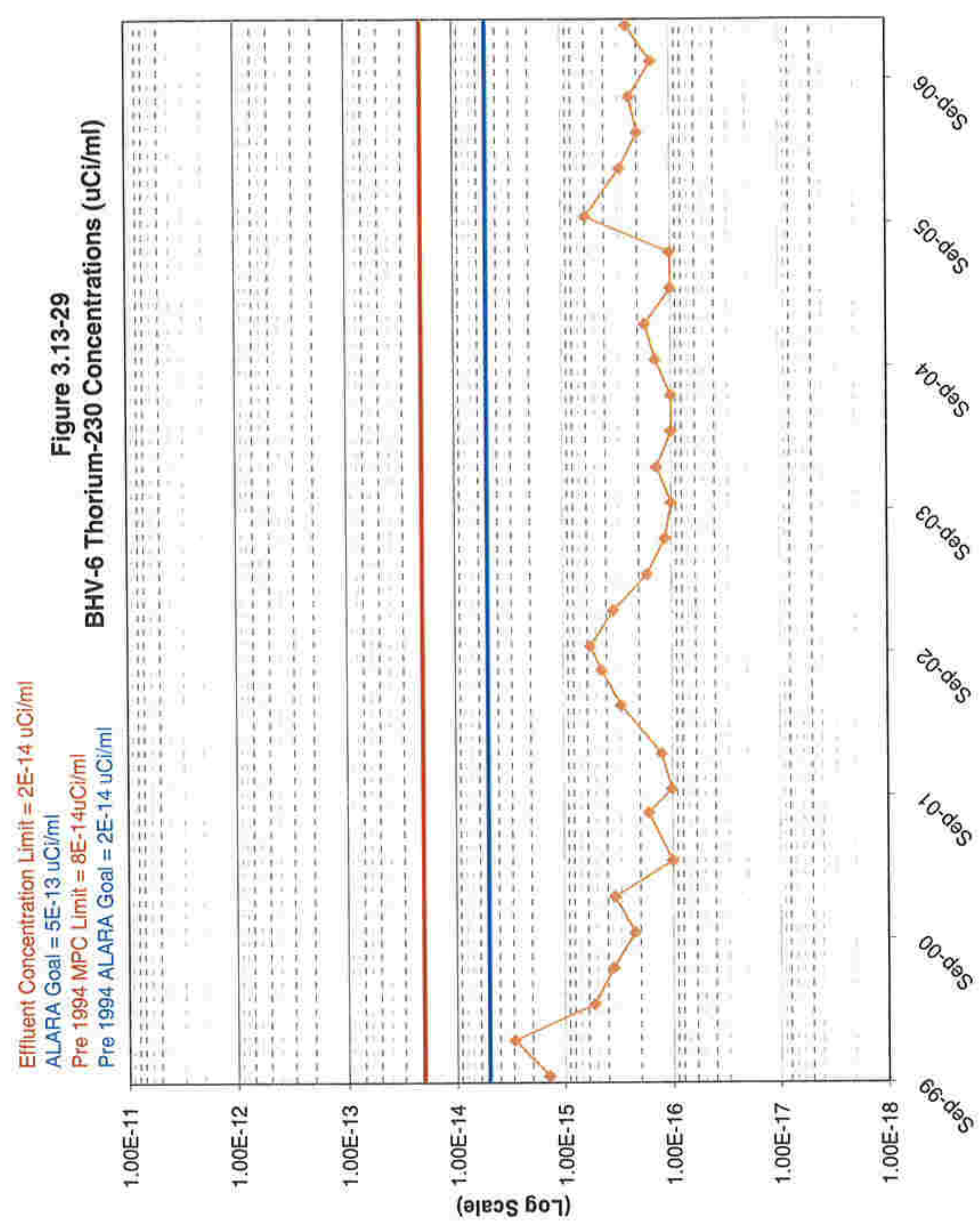


Figure 3.13-29
BHV-6 Thorium-230 Concentrations (uCi/ml)

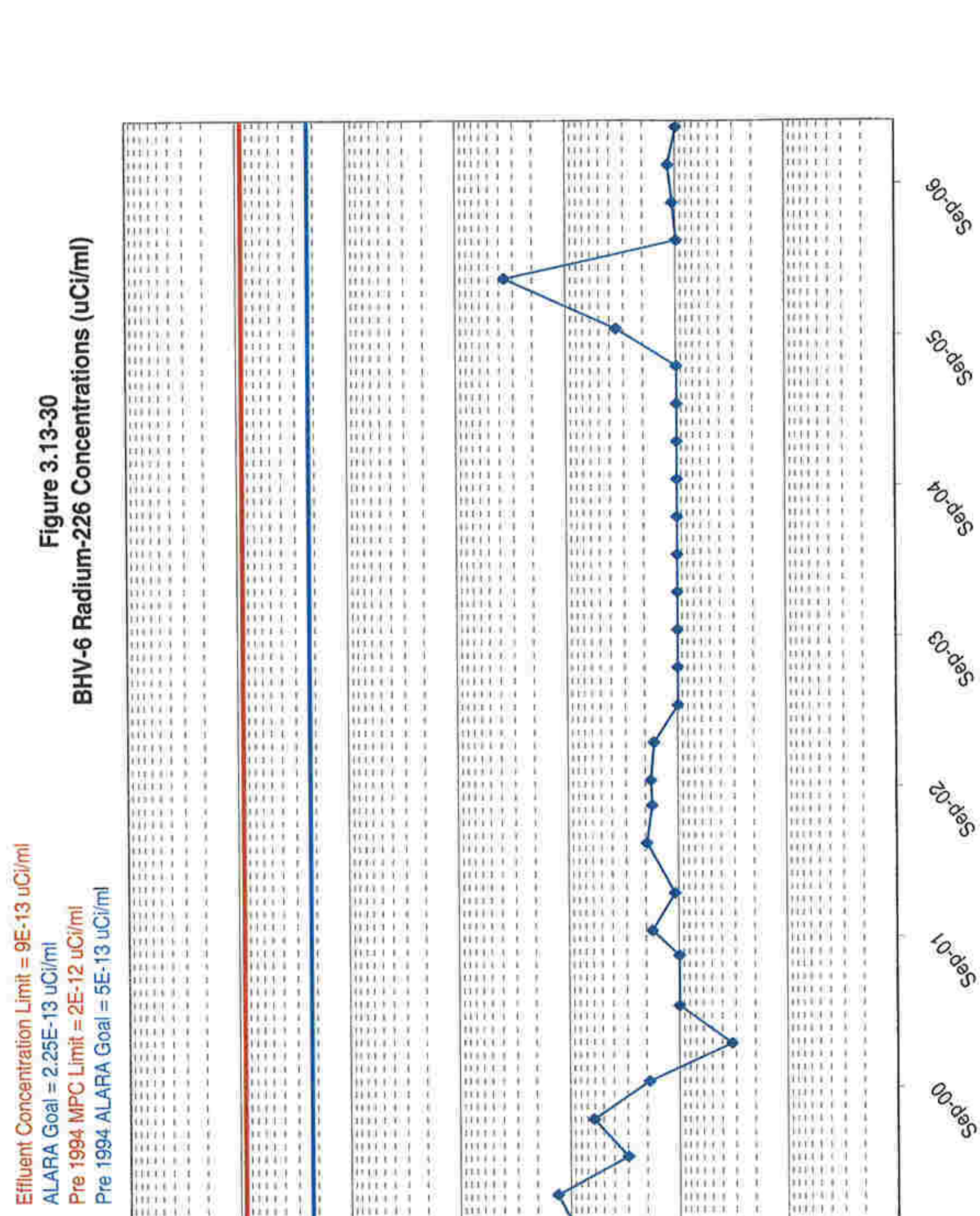


Figure 3.13-30
BHV-6 Radium-226 Concentrations (uCi/ml)
Effluent Concentration Limit = 9E-13 uCi/ml
ALARA Goal = 2.25E-13 uCi/ml
Pre 1994 MPC Limit = 2E-12 uCi/ml
Pre 1994 ALARA Goal = 5E-13 uCi/ml
(Log Scale)
1.00E-11
1.00E-12
1.00E-13
1.00E-14
1.00E-15
1.00E-16
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Sep-04
Sep-05
Sep-06

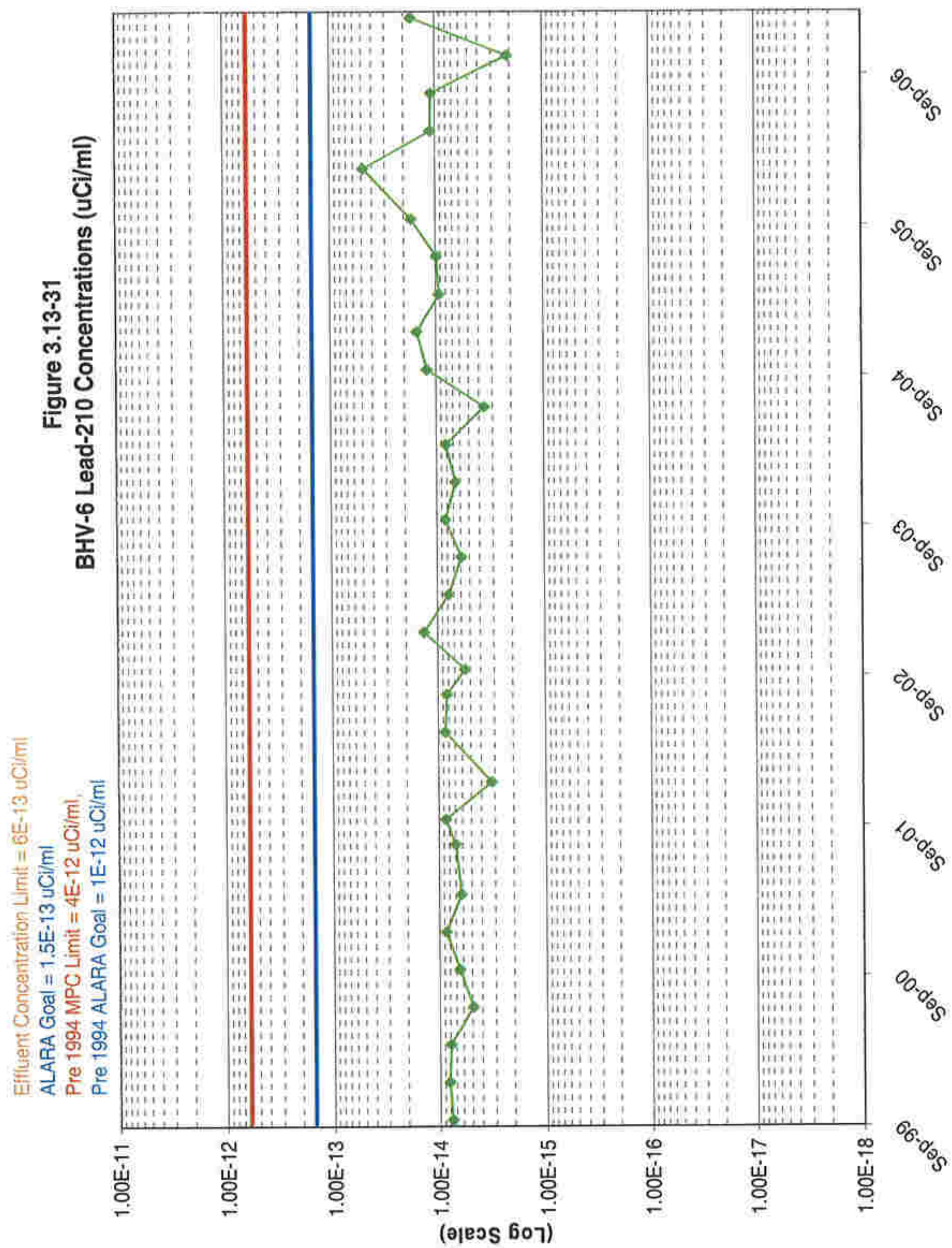


Figure 3.13-31
BHV-6 Lead-210 Concentrations (uCi/ml)

A review of the foregoing figures supports the conclusion that airborne particulate is well controlled at the Mill. The results of these analyses demonstrate that the facility has been consistent in its compliance with the Effluent Concentration Limits (ECL's) required by regulation (10 CFR 20, Appendix B, also incorporated by reference in R313-15-302).

The data obtained since program inception in 1981 indicates that only one individual quarterly measurement (Th-230 at BHV-5 for the 2nd Qtr, 1996) has ever exceeded the ECL at the Mill. With regard to this particular single measurement, while it is important to consider and evaluate an individual measurement exceeding the ECL, for public dose estimation purposes it is the annualized data that are of primary significance. In this instance, the annualized Th-230 data for BHV-5 in 1996 is well below the ECL for the annual period.

It is noteworthy, and expected, that while Pb-210 concentrations are ALARA. They are elevated in comparison to the other radionuclides tested (i.e. U-nat, Th-230 and Ra-226). This condition is experienced world-wide and is resulting from the ubiquitous presence of radon in the atmosphere. Accordingly, observed Pb-210 disequilibria cannot be attributed to the operation of the Mill.

Radon-222 emanates as a decay-chain progeny of the Radium-226 contained in the soil of the earths crust and is dispersed generally throughout the earth's atmosphere. The electrically charged short and long-lived decay products of Radon-222 attach to ambient dust particles found naturally in the atmosphere and are carried long distances. Lead-210 is the longest lived of these decay products and is the decay product of the shorter-lived radon progeny. As such, it accumulates as an electrical attachment on the natural ambient dust in the atmosphere and is generally measured at elevated activity when compared to local decay-chain parent nuclide activity, regardless of uranium milling activity. At the Mill's BHV air monitoring stations, all dust (ambient natural and Mill derived) is collected by the sample filter. Because of the natural elevation of Pb-210 accumulated as an attachment to the naturally occurring ambient dust particles collected by the air sampling equipment, Pb-210 is commonly elevated and in disequibrium when compared to parent nuclide activity, regardless of the Mill's presence. By way of illustration, average ground-level concentrations have been reported for selected States (NCRP Report 94, 1992) and are summarized in Table 3-13-7 below, demonstrating elevated Pb-210 activity where no uranium milling operations are located nearby. Lead-210 activity concentrations can be expected to be even higher for locations in the western U.S. where uranium ore bodies are commonly located.

Table 3.13-12
NCRP Report 94-Global Lead-210 Concentration Example

State	Pb-210 Concentration	
	(µBq/m^3)	(µCi/ml)
California	600	1.6E-14
Illinois	1500	4.1E-14
Ohio	300	8.1E-15
Massachusetts	700	1.9E-14

Source: January-June, 2006 Semi-Annual Effluent Report (Denison)

Evaluation of the data by comparison to the Mill's ALARA goals reveals that, with very few exceptions, the gross (background inclusive) measurements do not exceed the Mill's ALARA objectives which are 25% of the ECL. (In only 9 of the 1,984 gross radionuclide determinations did the measurement exceed the Mill's self-imposed ALARA threshold).

b) Radon

Due to the unavailability of monitoring equipment to detect the new 10 CRF standard of 0.1 pCi/l, with the approval of NRC, Radon 222 monitoring at BHV stations was discontinued in 1995. Instead, Denison demonstrated compliance with these limits and the requirements of R313-15-301 by calculation, authorized by the NRC and as contemplated by R313-15-302 (2) (a).

This calculation was performed by use of the MILDOS code for estimating environmental radiation doses for uranium recovery operations (Strenge and Bender 1981) and more recently in 2003 by use of the updated MILDOS AREA code (Argonne 1998). The analysis under both the MILDOS and MILDOS AREA codes assumed the Mill to be processing high grade Arizona Strip ores at full capacity, and calculated the concentrations of radioactive dust and radon at individual receptor locations around the Mill.

The MILDOS and MILDOS AREA codes calculated the combined Total Effective Dose Equivalent (TEDE) from both air particulate and radon at the nearest potential residence, approximately 1.2 miles north of the Mill, the public, as well as at all other receptor locations. These calculations revealed projected doses to be below the ALARA goal of 10 mrem/yr for air particulate as set out in R313-15-101(4). Radon has also been calculated to be within regulatory limits.

While confident that past modeling was sufficiently accurate, detection equipment hass improved since 1995. The Mill has decided to implement Alpha Track monitoring for radon at its environmental air monitoring stations commencing with the 1st Quarter of 2007.

c) External (Direct) Gamma

TLDs are co-located with the high volume air samplers at the BHV stations shown on Figure 3.3-2. In addition, TLDs continue to be installed at BHV-3. The quarterly results of the TLD measurements for 1999 (after subtracting the background measurements from BHV-3) are summarized in Table 3.13-8. 1999 was chosen as a reference year, because it is the year in which the last Mill run occurred. In some cases the BHV-3 background was higher than the measurements at the other sites. These values are in brackets indicating a negative value after subtracting the BHV-3 value.

Table 3.13-13
1999 TLD (Environmental) Gamma Dose (After Background Subtraction)

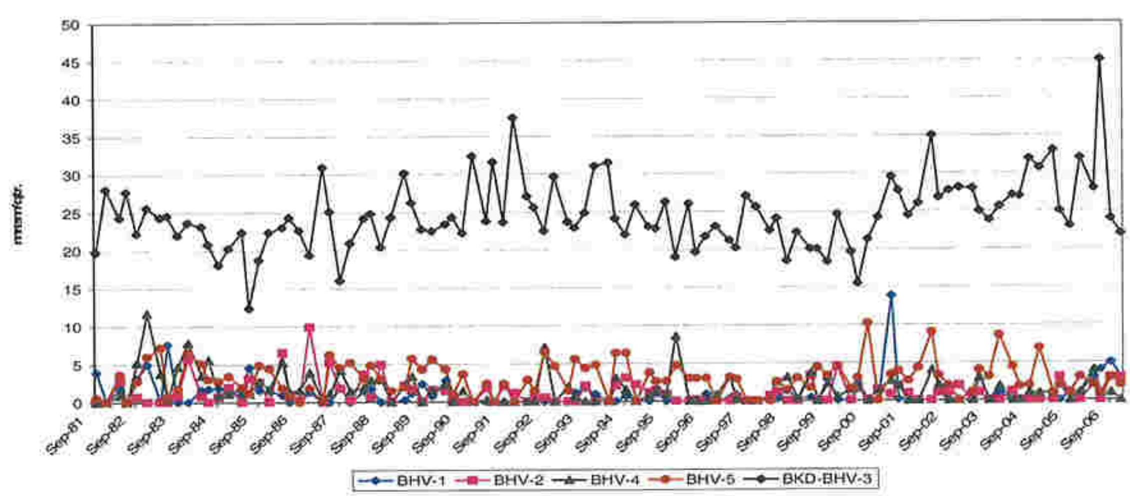
Location	Gamma dose (mrem/yr)						
	Jan 1/99-Apr 13/99	Apr 1/99-July 15/99	July 1/99-Oct 12/99	Oct 1/99-Jan 10/00	Maximum	Average	Minimum
BHV-1	1.00	(0.60)	3.80	0.00	3.80	1.05	(0.60)
BHV-2	5.20	0.00	(0.20)	6.40	6.40	2.85	(0.20)
BHV-4	6.00	0.00	3.00	0.80	6.00	2.45	0.00
BHV-5	2.80	7.60	4.60	6.60	7.60	5.40	2.80
BHV-6	2.40	0.60	3.40	2.00	3.40	2.10	0.60

Source: Mill monitoring data.

The measured levels at BHV-5 were the highest, reflecting proximity to the Mill's ore storage area. The gamma levels at BHV-1 were the lowest. Since BHV-2 is further from the Mill than BHV-1 and showed a higher annual gamma dose, it is likely that the gamma radiation levels at BHV-2 were in fact natural and un-impacted by activities at the Mill. Variations in naturally occurring radiation in soils and the use of phosphate fertilizer could readily explain such variations in natural background.

In addition to the 1999 measurements, gamma exposure rates have been measured at air stations BHV-1, BHV-2, BHV-3, BHV-4 and BHV-5 since the beginning of Mill operations in 1981. Figure 3.13-32 below depicts the measurements of record since that time, and further illustrates that incremental dose above background at BHV-3 remains low, regardless of the state of operations.

Figure 3.13-32
Background Subtracted and Background Environmental TLD Measurements (mrem/Qtr)



(d) Vegetation

Vegetation samples are collected at three locations around the Mill periphery. The sampling locations are: 1) Northeast, 2) Northwest and 3) Southwest of the Mill facility. The samples are collected during early spring, late spring and fall (e.g. the growing seasons). A graphical log-scale presentation of the radionuclide uptake in vegetation as observed over time since 1998, prior to and after the most recent natural ore mill run, is provided in Figures 3.13-33 and 3.13-34. For these graphs the "less than" values and zeros have not been plotted as the results are not comparable to any regulatory limit (i.e. the vegetation sampling data is utilized for dose modeling purposes only, when appropriate). The 2006 data compared to the results of previous years indicate no increase in uptake of Ra-226 or Pb-210 in the vegetative growth collected and are within the variation of previous sampling episodes. It should be noted that vegetation samples in recent years were collected during a period of severe drought in San Juan County. For this reason sampling was dramatically affected due to the scarcity of available vegetative species at the respective sampling locations.

Figure 3.13-33
Ra-226 Concentrations In Vegetation (uCi/Kg)

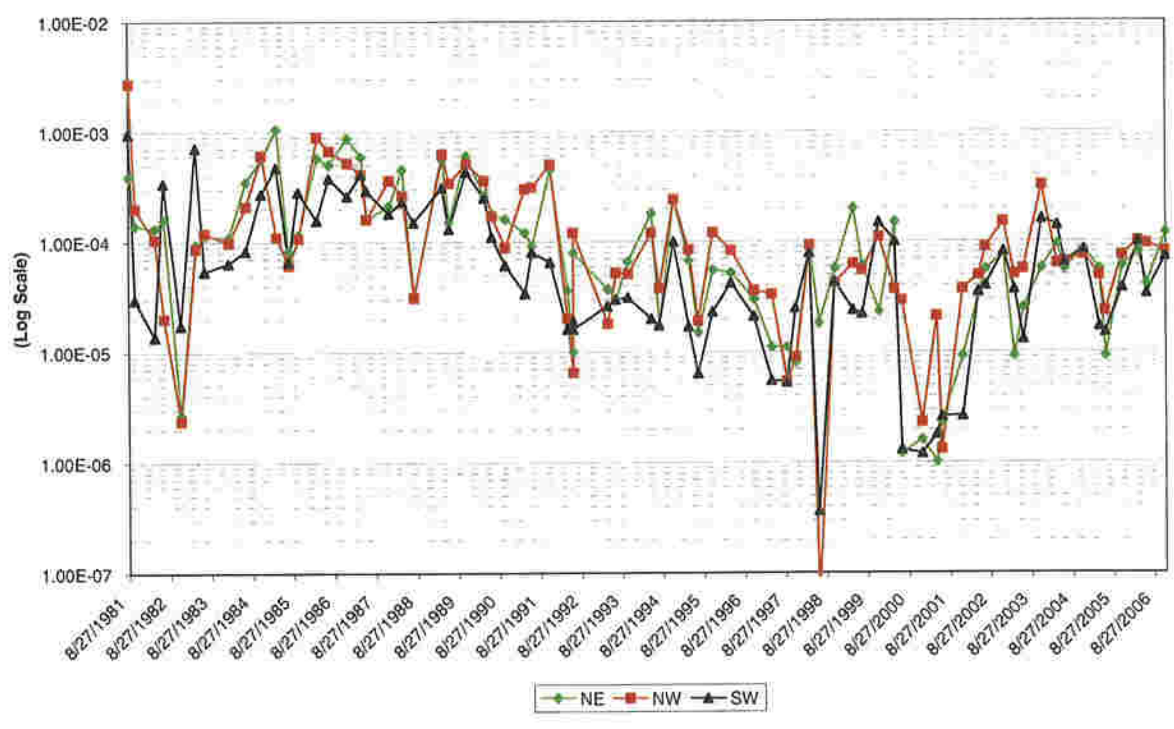
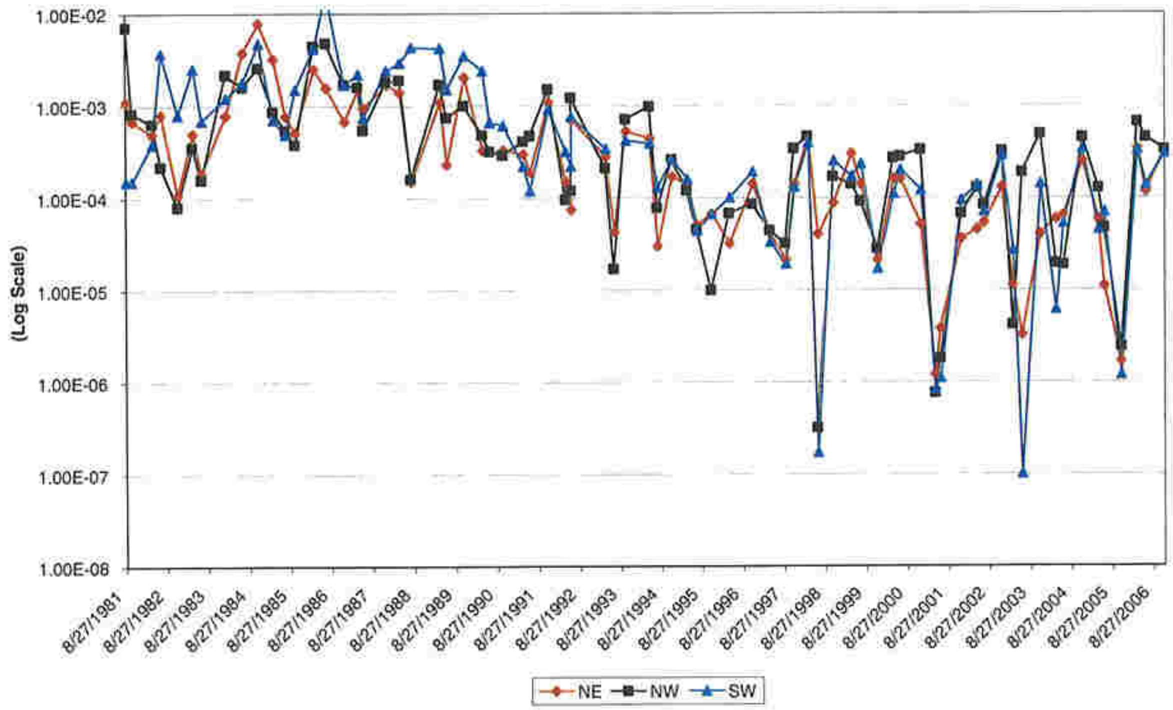


Figure 3.13-34
Pb-210 Concentrations In Vegetation (uCi/Kg)



(e) Stack Releases

The Mill has three stacks associated with yellowcake production: the north yellowcake dryer; the south yellowcake dryer and the yellowcake baghouse. Denison measures uranium in stack emissions from these stacks when the Mill is operating. In addition, when the Mill is producing yellowcake for more than one consecutive quarter, the stack testing program also includes measurements of Ra-226, Th-230, and Pb-210 in the particulate. The yellowcake dryers were operated during the 1995/1996 and 1999 Mill runs. Table 3.13-9 sets out the stack sampling results for the Mill run when the high-grade Arizona Strip ores were processed. As stated previously, the Arizona strip ores are representative of the upper bound for natural ore processing. During the 1995/1996 processing campaign both the north and south yellowcake dryers were operating, and representing the most conservative case for yellowcake scrubber emission.

Table 3.13–14
1995/1996 Mill Stack Sampling Results[1]

Parameter	Detection Limit	North Yellowcake Stack	South Yellowcake Stack	Yellowcake Baghouse Stack
U_{nat} µCi/ml	9E -14	4.17E–10	3.72E–10	6.38E–11
Ra–226 µCi/ml	2E -14	2.47E-14 ± 2.24E-14	1.87E-14 ± 1.36E - 14	9.43E-14 ± 1.85E -14
Th–230 µCi/ml	2E -15	1.49E-13 ± 7.04E-14	2.35E-13 ± 4.71E - 14	4.07E-13 ± 8.27E -14
Pb–210 µCi/ml	2E -15	3.28E-13 ± 1.05E-14	1.43E-12 ± 6.18E - 13	9.62E-13 ± 5.23E -13
U_{nat} Release Rate (Kg/Qtr)	NA	2.9	2.1	0.4
U_{nat} Release Rate (Ci/Qtr)	NA	1.99E-03	1.45E-03	2.76E-4

Source: Mill Semi Annual Effluent Reports.
[1] The annualized release rate for uranium was estimated by summing the quarterly release rates reported in the Table and multiplying the sum by four.

From this data, the uranium release rate stated as Ci/quarter on an annualized basis, can be calculated for the processing of high grade Arizona Strip ores to be 1.49E-02 Ci/yr from the yellowcake scrubber, which is less than the emissions modeled in the FES of 2.9E-02 Ci/yr U-238 (see Table 3.13-2). Similarly, the annualized release rates for Th-230 and Ra-226 can be calculated to be 1.38E-05 and 2.4E-06 Ci/yr[9], which are less than the levels modeled in the FES of 1.6E-03 and 6.2E-05 Ci/yr.

The stack sampling results for the 1999 Mill run, in which a smaller quantity of lower grade ores was processed and only the north yellowcake dryer was used, indicated lower emission levels for all measured radionuclides as compared to the 1995/1996 Mill run. The annualized release rates for Unat, Th-230 and Ra-226 can be calculated to be 5.14E-03, 1.21E-06 and 6.94E-06. Similarly, yellowcake scrubber stack tests conducted during product drying campaigns for the 2006 alternate feed processing have been lower than those exhibited during the 1995/1996 Mill run.

For the purposes of the 2007 MILDOS assessment the more conservative (larger) EnechoTech release rates were utilized for dose estimation purposes in both ore processing scenarios.

(f) Surface Water

See Section 3.7.1 above.

(g) Groundwater

See Section 3.7.2 above.

(h) Soils

Soil samples are collected annually at each of the BHV-1, BHV-2, BHV-3, BHV-4 and BHV-5 locations and analyzed for U_{nat} and Ra-226. Soil sampling data, laboratory analyses and graphical representations, since the Mill's inception of this program, are provided in the Semi-

[9] The annualized release rate for Ra-226 and Th-230 were scaled from the annualized uranium release rate on the basis of the relative quarterly concentrations reported in Table 3.13-7.

Annual Effluent Reports. No obvious trend is evident in any of the sample location data sets. Sample results obtained since the previous licensure demonstrate that soil nuclide concentrations are low (less than unrestricted release requirements). These data are presented in Table 3.13-10.

Table 3.13-15
Soil Sample Concentrations
(Values x 1.0E-3 µCi/Kg)

Date	BHV-1		BHV-2		BHV-3		BHV-4		BHV-5	
	Ra-226	U-Nat	Ra-226	U-Nat	Ra-226	U-Nat	Ra-226	U-Nat	Ra-226	U-Nat
1997	0.54	0.31	0.56	0.16	0.27	0.27	0.26	0.26	1.50	1.50
1998	1.60	3.05	0.70	0.58	0.50	0.45	1.00	1.19	3.00	2.76
1999	2.27	1.74	0.78	0.84	0.53	0.42	0.84	0.77	3.27	3.15
2000	1.55	1.21	0.81	0.53	*	*	0.83	1.22	3.81	3.25
2001	1.00	1.00	0.60	0.30	0.04	0.30	0.90	1.00	1.20	1.11
2002	1.30	1.35	0.90	0.52	0.50	0.30	1.20	1.49	2.40	2.81
2003	0.80	0.99	0.60	0.79	0.50	0.33	0.60	0.43	2.80	4.20
2004	0.60	0.61	0.40	0.25	0.40	0.22	0.60	0.51	1.00	1.40
2005	0.90	0.96	0.70	0.34	0.60	0.27	0.60	0.38	0.70	0.41
2006	0.70	0.76	0.44	0.25	0.41	0.25	0.52	0.48	1.40	1.30

* Data not available

(i) Radon Emanation from Tailings

Clean Air Act (CAA) NESHAPs requires that the Mill demonstrate on an annual basis that, on average, the radon flux from existing uranium mill tailings piles not exceed 20 pCi/m^2/s. In order to satisfy this requirement, the radon flux from tailings surfaces at the Mill are measured and reported to the State of Utah on an annual basis. These data consistently demonstrate that the radon flux from the surfaces of tailings at the Mill are below the NESHAP's criteria, which, according to EPA, protects public health and safety with an ample margin of safety. Table 3.13-13 shows the radon emanation rates from the Mill's tailings cells over the most recent five year record. It should be noted that at the time of this writing the report for the 2006 tests had not yet been received by Denison from its radon test contractor, and as a result the 2006 data could not be included.

Table 3.13-16
Annual Radon Emanation Testing
Tailings Cells 2 & 3 (pCi/m²-sec) [10]

Year	Rn-222 Emanation-Cell 2	Rn-222 Emanation-Cell 3
1997	12.1	16.8
1998	14.3	14.9
1999	13.3	12.2
2000	9.3	10.1
2001	19.4	10.7
2002	19.3	16.3
2003	14.9	13.6
2004	13.9	10.8
2005	7.1	6.2

Source: Mill NESHAPS Reports.

The values reported for 2001 and 2002 were elevated when compared to prior years testing. It is Denison's belief that these emanation rates were largely due to the drought conditions in those years, which reduced the moisture content in the interim cover placed over the inactive portions of tailings Cells 2 and 3. In addition, the commencement of the 2002 Mill run, which resulted in increased activities on the tailings cells, may have contributed as well. As a result of the higher radon emanation rates experienced in 2001 and 2002, additional interim cover was placed on the inactive portions of Cells 2 and 3 in order to reduce radon flux to the levels measured in previous years. While this effort was successful, additional cover was again applied to the tailings in 2005, further reducing radon emanation to well below the NESHAPS standard of 20 pCi/m^2-sec.

3.13.2.8 Occupational Doses

The FES notes that uranium mills are designed and built to minimize the exposure of mill workers, that occupational exposures for workers are monitored and kept below regulatory limits, and that workplace radiation protection measures are periodically reviewed and updated as appropriate. NRC staff also comment in the FES that based on staff review of mill exposure data, uranium mill workers were unlikely to be exposed to more than 25% of NRC's permissible limits. See FES Section 4.7.6. The actual doses to workers at the Mill have in fact been low, as illustrated in the following discussion.

Denison has implemented a comprehensive radiological workplace and worker monitoring program at the Mill. Radiological monitoring of the Mill workplace includes area measurements of external gamma radiation, radon decay progeny and long-lived alpha activity in airborne dust.

(a) Dose Limits

In order to provide a context for the workplace and worker monitoring data given below, it is necessary to briefly comment on the current NRC dose limits for workers which are given in 10

[10] Radon flux measurements are made on the cover area and beach area of tailings Cell 2 and tailings Cell 3. The mean area weighted radon flux for the total tailings area is then calculated with the results as shown in the table.

CFR Part 20 (R313-15-201). The fundamental dose limit is given in terms of a TEDE which, in effect, is the sum of the deep dose equivalent for external gamma exposures and the committed effective dose equivalent for internal exposures from radionuclides taken into the body, through, for example, inhalation of radioactive dust and radon. The term "committed" simply means that all of the dose attributable to the intake of a radionuclide during the 50 year period after intake is taken into account and assigned to the year of intake. Both doses are reported in "rems".

The deep dose equivalent is the standard measure of the "whole body" dose from external gamma radiation. The committed effective dose equivalent is the standard measure of the whole body dose from radioactivity in internal organs and tissues (summed over all organs using appropriate weighting factors for radiation quality and radio-sensitivity of the various organs).

While the basic dose limit set out in 10 CFR Part 20 (R313-15-201) is a TEDE dose of 5 rem (5,000 mrem) per year, in practice the dose from internally deposited radioactivity is determined through the use of derived limits. The Derived Air Concentrations "DAC's" are the concentrations of airborne radioactivity which, if inhaled by a worker for an entire working year (assumed to be 2,000 hours), would result in a committed effective dose equivalent of 5 rem. These DAC's are commonly used to control occupational exposures.

10 CFR Part 20 (Appendix B, Table 1) which is incorporated by reference into R313-15-201, also provides a DAC for Rn-222 of 0.33 ("Work Levels") WL. A full year of exposure to radon decay progeny of 0.33 WL is assumed to carry the same risk as exposure to 5 rem. Thus, the workers TEDE doses can be assessed using a sum of fractions rule as follows:

$$\text{Annual TEDE} = (\text{gamma}/5) + t/2{,}000\{(C_A/DAC_A + C_B/DAC_B + C_C/DAC_C\ldots) + (WL/0.33)\}$$

Where:

- gamma is the annual workplace gamma dose in rems
- C_A is the average workplace air concentration of radionuclide A, in μCi/ml
- DAC_A is the derived concentration for radionuclide A, in μCi/ml
- WL is the average workplace exposure to radon decay progeny (WL)
- t is the time of exposure (hours)
- 2000 is the normal number of working hours per year

(b) ALARA Program

The Mill uses, to the extent practicable, procedures and engineering controls, based upon sound radiation protection principles, to achieve occupational doses and doses to members of the public that are ALARA. Under the Mill's ALARA Program, the mill has set a goal of maintaining occupational exposures to levels that are no more than 25% of regulatory standards, to the extent reasonably achievable. In addition to engineering controls, the Mill requires mandatory use of respirators in areas of higher airborne particulate. and manages worker time in higher gamma radiation areas as two measures to keep exposures within regulatory limits and ALARA.

(c) Use of Respirators

10 CFR Part 20, Appendix A sets out protection factors for respirators to be used where the contaminants have been identified and the concentrations (or possible concentrations) are known. The protection factor is a measure of the degree of protection afforded by a respirator, defined as the ratio of the concentration of airborne radioactive material outside the respiratory protective equipment to that inside the equipment (usually inside the facepiece) under conditions of use. It is applied to the ambient airborne concentration to estimate the concentrations inhaled by the wearer according to the following formula:

Concentration inhaled = (Ambient airborne concentration)/(Protection Factor)

The concentration inhaled, as determined by use of this formula, is then compared to the applicable DAC to determine regulatory compliance. Likewise, for administering the Mill's ALARA Program, an ambient airborne concentration that is expressed as a percentage of DAC can be divided by the specific respirator protection factor to arrive at the percentage of DAC if a respirator is used.

Typically, depending on the circumstances, the Mill employs the use of full or half-mask negative pressure (i.e., negative phase during inhalation) respirators, with a protection factor of 50. In certain circumstances the Mill also uses powered air purifying respirators (PAPR) with radiological dust cartridges, that have a protection factor of 1,000. Other respiratory equipment is used at the Mill as required in special circumstances.

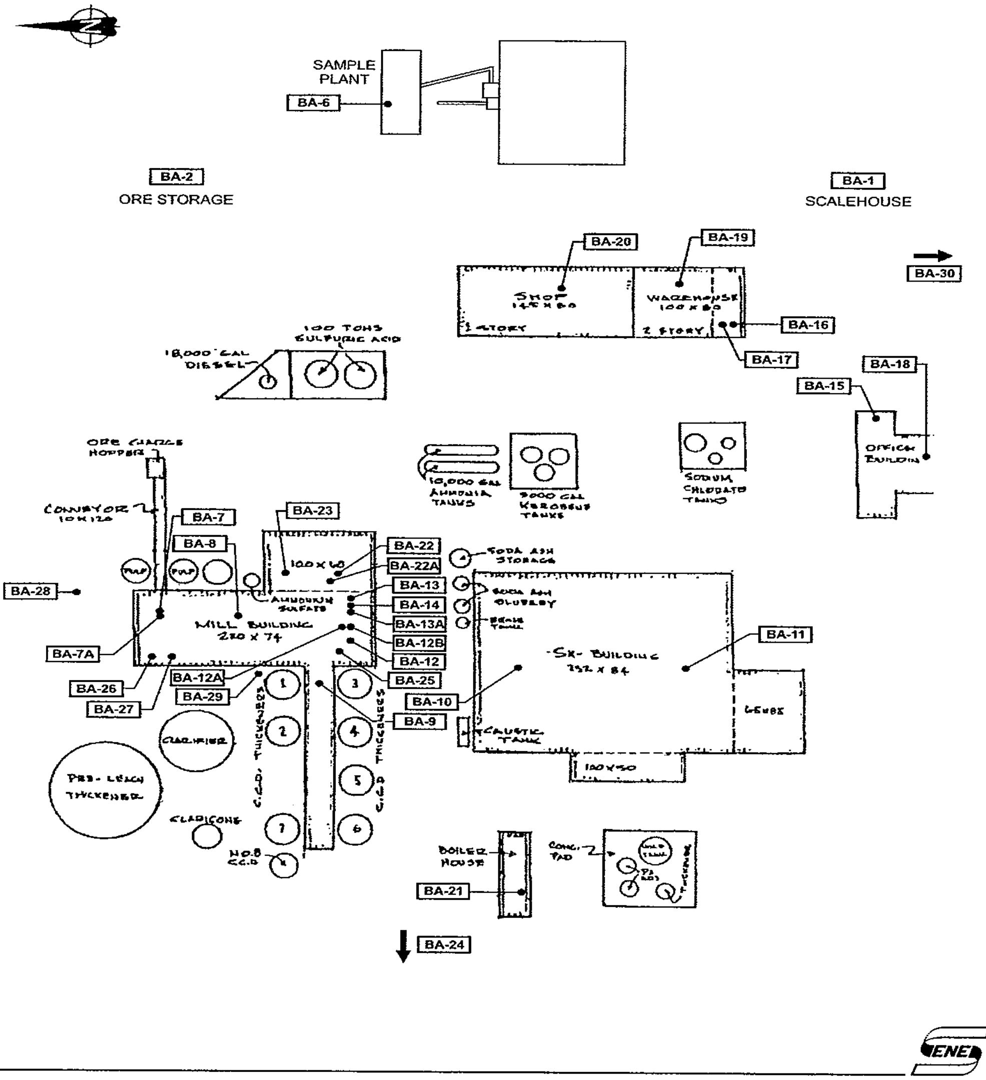
(d) Workplace Airborne Activity Monitoring Locations

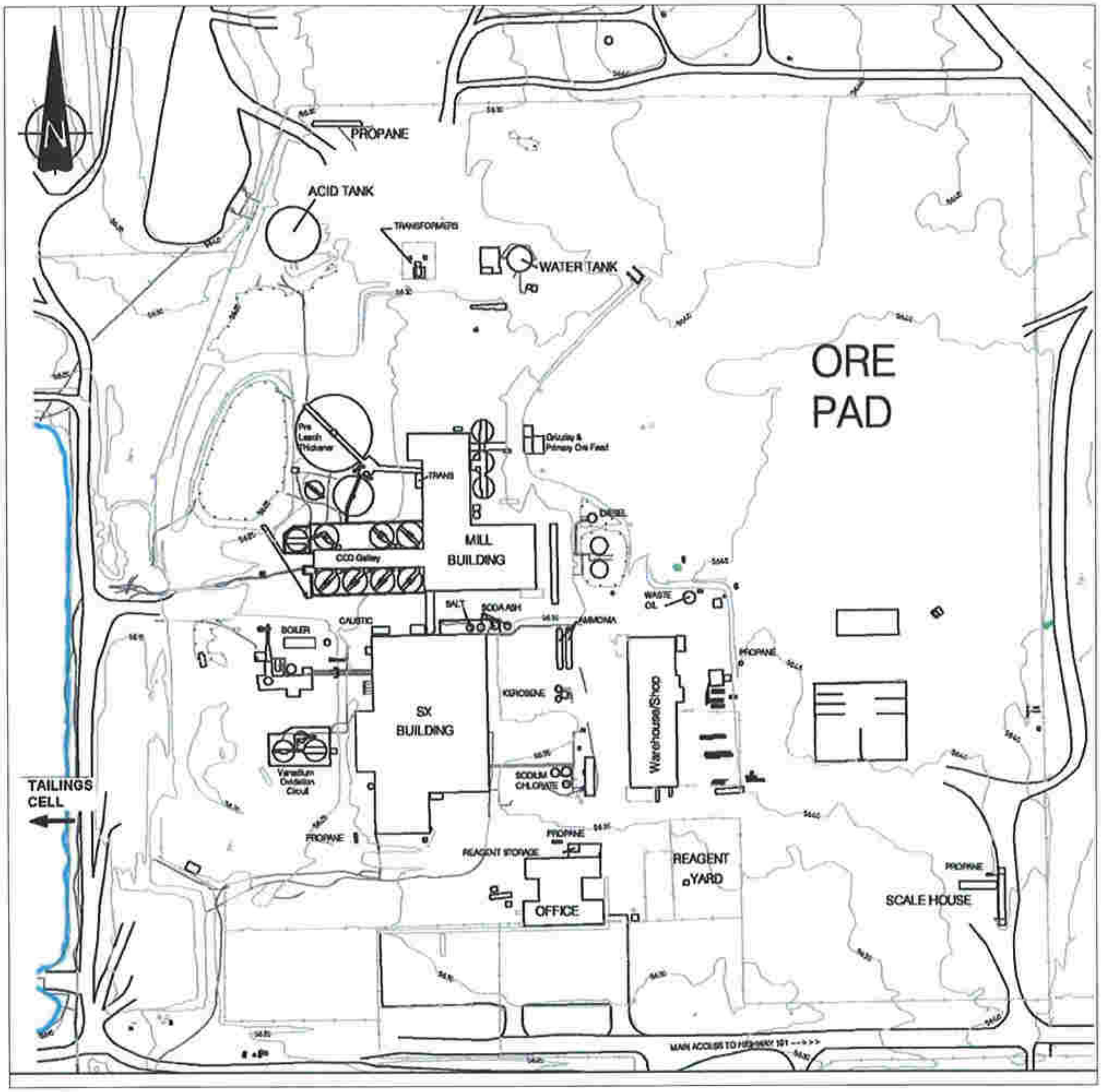
Figure 3.13-35 shows the occupational airborne activity monitoring locations at the Mill. The corresponding identification codes for each monitoring location are provided in Table 3.13-12.

Airborne dust and gamma radiation levels are routinely collected in areas at the Mill with potential for worker exposure. The general site is shown in Figure 3.13-36.

Figure 3.13-35

OCCUPATIONAL AIRBORNE ACTIVITY MONITORING LOCATIONS (PARTICULATE & RADON) AT THE WHITE MESA MILL





100 0 100 200 300 feet

SCALE 1"=250'

Denison Mines (USA) Corp.			
Project	WHITE MESA MILL		
REVISIONS	County:	State: UT	
Date / By	Location:		
	Figure 3.13-36 Site Map of The White Mesa Mill Showing Location of Buildings and Tankage		
	Scale: as shown	Date: Feb. 2007	figure 3.13-36.dwg
	Author: bm	Drafted By: B. Munkhbaatar	

Z:\White Mesa Mill\2007 License Renewal Application\Environmental Report - Figures\figure 3.13-36.dwg, Figure 3.13-6, 02/27/2007 8:42:35 AM, Adobe PDF.pc3, Letter

Table 3.13-17
Mill Airborne Activity Monitoring Locations

Identification Code	Location
BA-1	Ore Scalehouse
BA-2	Ore Storage
BA-6	Sample Plant
BA-7	Sag Mill Area
BA-7A	Sag Mill Control Room
BA-8	Leach Tank Area
BA-9	CCD Circuit Thickeners
BA-10	SX Building North Area
BA-11	SX Building South Area
BA-12	YC Precipitation & Wet Storage Area
BA-12A	North YC Dryer Enclosure
BA-12B	South YC Dryer Enclosure
BA-13	YC Precipitation & Wet Storage Area
BA-13A	YC Packaging Enclosure
BA-14	Packaged YC Staging Area
BA-15	Metallurgical Lab Sample Prep Room
BA-16	Lunch Room Area (New Training Room)
BA-17	Change Room
BA-18	Administration Building
BA-19	Warehouse
BA-20	Maintenance Shop
BA-21	Boiler
BA-22	Vanadium Panel
BA-22A	Vanadium Dryer
BA-23	Filter Belt/Rotary Dryer
BA-24	Tails
BA-25	Control Room
BA-26	Shifters Office
BA-27	Operators Lunch Room
BA-28	Dump Station
BA-29	Filter Press
BA-30	Truck Shop

Source: Radiation Protection Manual

To facilitate the discussion of occupational exposures, the individual workplace monitoring locations shown in Figure 3.13-35 and listed in Table 3.13-12 were grouped according to factors such as proximity to Mill processes, type of exposure and similarity of DACs. For example, the monitoring locations at the SAG mill and at the SAG mill control are grouped together due to their proximity and similarity of activities. Other groupings were assembled in a similar manner. These groupings are shown in Table 3.13-13. Each grouped location indicated in the first column of Table 3.13-13 is assigned its own DAC; similarly, each workplace location indicated in the fourth column uses the DAC for the respective grouped location

Table 3.13-18
Grouped Workplace Locations for Airborne Particulate and Radon Monitoring

Grouped Location[11]	Secondary Grouping	ID Code	Workplace Location
Ore-Grind	Southeast of Mill	BA-1	Ore Scalehouse
		BA-2	Ore Storage
		BA-20	Maintenance Shop
		BA-19	Warehouse
		BA-16	Lunch Room
		BA-17	Change Room
		BA-18	Administration Building
	Outside of Mill	BA-28	Dump Station
	Inside the Mill	BA-7	SAG Mill
		BA-7A	SAG Mill Control
		BA-26	Shifter's Office
		BA-27	Operations Lunch Room
		BA-29	Filter Press
	Inside the Mill, Just Outside YC Areas	BA-25	Control Room
Leach		BA-8	Leach Tank Area
CCD		BA-9	CCD Circuit Thickeners
SX	SX	BA-11	SX Building South
	(Outside SX)	BA-21	Boiler
Yellowcake Precipitation		BA-12	Yellowcake Precipitation and Wet Storage Area
Yellowcake Packaging:	Yellowcake Enclosure	BA-12A BA-12B BA-13A	North Yellowcake Dryer Enclosure South Yellowcake Dryer Enclosure Yellowcake Packaging Enclosure
	Yellowcake Packaging	BA-13	Yellowcake Drying and Packaging Area
	Yellowcake Staging (Storage)	BA-14	Packaged Yellowcake Staging Area
Tailings		BA-30	Truck Shop
		BA-24	Tailings

Source: Radiation Protection Manual

(e) Airborne Dust

The routine airborne particulate radioactivity levels are reported in terms of gross alpha activity. These measurements can be compared to DAC's developed by Denison for each stage of the process and approved by NRC. The relevant DAC is defined according to the source of airborne dust (e.g. from ore, tailings or yellowcake), the lung solubility class according to the chemical

[11] DAC's for vanadium workplace locations are not included in this analysis

form of the radionuclides and the relative abundance of the radionuclides. The basis for the current NRC approved DAC's is summarized in Table 3.13-14.

Table 3.13-19
Solubility Class, Chemical Form and Abundance of Feed Material at the Mill

Location	U_{nat}	Th-230	Ra-226	Pb-210
Ore-Grind	DAC is specified in 10 CFR Part 20			
Leach	½ Ore, ½ Precipitation	½ Ore, ½ Precipitation	½ Ore, ½ Precipitation	½ Ore, ½ Precipitation
CCD	Class D Sulfate 25%	Class W [1] Sulfate 25%	Class W [1] Sulfate 25%	Class D [1] Sulfate 25%
SX	Class D Sulfate 25%	Class W [1] Sulfate 25%	Class W [1] Sulfate 25%	Class D [1] Sulfate 25%
Precipitation	Class D [2] Diuranate 100%	NA	NA	NA
Yellowcake Packaging	Class Y: 90 % and Class W: 10 % Oxide 100%	NA	NA	NA
Tailings	Class Y Oxide 4%	Class Y [2] Oxide 32%	Class W [1] Oxide 32%	Class W [1] Oxide 32%

Source: Radiation Protection Manual

[1] 10 CFR Part 20, Appendix B
[2] NUREG/CR-0530, PNL-2870, D.R. Kalkwarf, 1979, "Solubility Classifications of Airborne Products from Uranium Ores and Tailings Piles"

The actual results of the airborne dust monitoring for 1999, the most recent year in which conventional ores (Colorado Plateau) was processed, corresponding to the grouped locations are shown in the following Table 3.13-15 along with the percentage of the DAC that the measured concentrations represent. These data demonstrate that the airborne radioactive particulate concentrations for typical Mill operations are well below the corresponding DACs. Data for the 2006 Mill run in not available as of the date of this report. However, the 1999 conventional ore Mill run is considered to be representative of typical full scale Mill operations.

Table 3.13-20
Particulate Concentrations (Gross Alpha) in Workplace Locations for 1999 Mill Run

Grouped Location	DAC (µCi/ml)	Individual Location	Production Period Concentration (µCi/ml)	Production Concentration (% of DAC)	Non-Production Period Concentration (µCi/ml)	Non-Production Concentration (% of DAC)
Southeast of Mill	6.00E-11	Ore Scalehouse	1.46E-12	2.43	NA	NA
		Ore Storage	2.41E-12	4.01	NA	NA
		Maintenance Shop	2.06E-12	3.44	NA	NA
		Warehouse	1.26E-12	2.11	NA	NA
		Lunch Room	7.33E-13	1.22	NA	NA
		Change Room	3.19E-12	5.32	NA	NA
		Administration Bldg	1.41E-12	2.35	NA	NA
		Average			NA	NA
Outside of Mill	6.00E-11	Dump Station	2.06E-11	34.26	3.72E-13	0.62
Inside the Mill	6.00E-11	SAG Mill	1.34E-11	22.27	3.37E-12	5.62
		SAG Mill Control	1.90E-12	3.17	3.49E-12	5.81
		Shifter's Office	1.56E-12	2.59	4.96E-13	0.83
		Operations Lunch Rm	7.49E-13	1.25	1.80E-13	0.30
		Filter Press	5.71E-12	9.51	N/D	ND
		Average	4.66E-12	7.76	1.88E-12	3.14
Leach	5.00E-10	Leach Tank Area	1.58E-12	0.32	8.40E-13	0.17
CCD	1.20E-11	CCD Circuit Thickeners	1.25E-12	10.41	2.59E-12	21.58
SX	1.20E-11	SX Building South	1.62E-12	13.50	2.48E-13	2.07
		Boiler	3.05e-13	2.54	N/D	N/D
Inside Mill, outside YC	6.00E-11	Control Room	1.46E-12	2.43	5.15E-13	0.86
Yellowcake Precipitation	5.00E-10	YC Precipitation &Wet Storage	1.59E-12	0.32	6.40E-13	0.13
Yellowcake Enclosure	2.20E-11	North YC Dryer Enc	1.20E-11	54.57	2.53E-12	11.48
		South YC Dryer Enc	5.24E-12	23.81	1.34E-12	6.11
		YC Pkg Enclosure	3.68E-12	16.71	6.04E-13	2.75
		Average	6.97E-12	31.70	1.49E-12	6.78
Yellowcake Packaging		YC Drying & Packaging Area	2.73E-12	12.40	5.68E-13	2.58

Grouped Location	DAC (µCi/ml)	Individual Location	Production Period Concentration (µCi/ml)	Production Concentration (% of DAC)	Non-Production Period Concentration (µCi/ml)	Non-Production Concentration (% of DAC)
Yellowcake Staging (Storage)		Packaged YC Staging Area	2.22E-12	10.08	6.22E-13	2.83
Tailings	1.70E-11	Truck Shop	8.51E-13	5.01	NA	NA
		Tailings	6.95E-13	4.09	NA	NA
		Average	7.73E-13	4.55	NA	NA

Source: Mill Monitoring Data

It should be noted that several of these locations (e.g. yellowcake enclosures) are areas where mandatory respiratory protection is required, and thus potential exposures to workers in these areas would be lower than suggested by the simple application of data in Table 3.13-15. See Section 3.13.1.8.c.

f) External Gamma

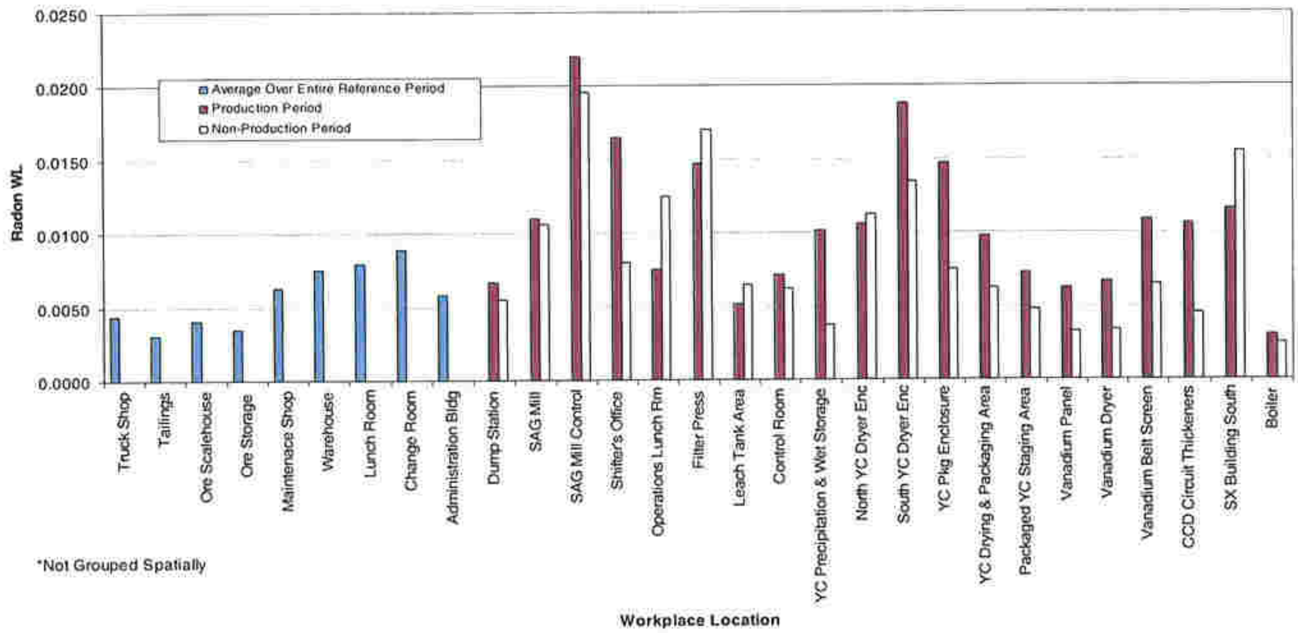
Gamma radiation is continuously monitored by TLD measurements at numerous fixed locations within the Mill and at nearby locations on the property where workers may be exposed. Figure 13.13-37 shows the individual gamma dose rates at individual workplace locations for both the production and the non-production periods in 1999. The average gamma levels for key work areas are summarized in Table 3.13-16.

Table 3.13-21
Average Radon Decay Progency and Gamma
(Measured During the 1999 Mill Run)

Area	RDP (WL)	Gamma (mrem/h)
Leach	0.005	0.05
CCD	0.011	0.01
SX	0.012	0.01
YC Precipitation	0.010	0.06
YC Enclosure	0.015	NA
YC Packaging	0.010	0.13
YC Storage	0.007	0.04
Tailings	0.004	0.04

Source: Mill Monitoring Data

Figure 13.13-37
Period Average Radon WL in Workplace Locations
Production and Non-Production Periods (1999)



g) Radon

Conventional ores and some of the alternate feed materials that have been processed at the Mill contain Ra-226 and therefore are a source of Rn-222. The results of monthly measurements at the fixed monitoring locations are shown in Figure 3.13-7 and summarized for key work areas in Table 3.13-16. The regulatory limit (DAC) for radon in the work place is 0.33 WL. The measured values are a factor of ten smaller than the DAC.

Figure 3.13-38 illustrates the average radon working levels in the various workplace locations in 1999 for production and non-production periods.

h) Worker Dose

Worker doses from external gamma radiation are monitored continuously at the Mill by personal TLD badges. The doses from internal radionuclides and radon are determined from workplace airborne radioactivity measurements and analysis of how much time each worker spends in each workplace.

From the data for all workers who were present throughout the full duration of one or both of the recent full Mill runs (1999 and 1995/1996), the average and maximum Mill workforce TEDE doses were calculated as summarized in Table 3.13-17. The TEDE doses are well below NRC's dose limit of 5 rem per year, and the ALARA goal of 1.25 rem per year.

Table 3.13-22
Mill Workforce TEDE Dose (Rem)
(Annual Dose Limit Of 5 Rem)

Production Period	Average Dose	Maximum Individual Dose
1999	0.17	0.68
1995/96	0.35	1.1

Source: Mill monitoring data

In addition to these data, the doses computed for workers at the plant from 1997 to 2005 (the most current year for completed dose computation) were evaluated. The results of that evaluation are provided in Table 3.13-18.

Table 3.13-23
Occupational Doses-1997 Through 2005 (Rem)

Year	TEDE		CEDE		Mill Production (Y/N)	Ore Feed Processed
	Max.	Ave.	Max	Ave		
1997	0.91	0.27	0.83	0.23	Y	Alternate Feeds
1998	1.41	0.35	1.27	0.29	Y	Alternate Feeds
1999	0.45	0.17	0.29	0.12	Y	Alternate Feeds & Colorado Plateau Ore
2000	0.23	0.12	0.10	0.07	N	-
2001	0.29	0.16	0.03	0.02	N	-
2002	0.19	0.09	0.08	0.04	Y	Alternate Feeds
2003	0.29	0.10	0.05	0.03	Y	Alternate Feeds
2004	0.10	0.06	0.04	0.03	N	-
2005	0.15	0.06	0.05	0.03	Y	Alternate Feeds

The data presented in Table 3.13-18 demonstrate that, with the exception of the year 1998, doses were consistent with that experienced during the 1995/96 and 1999 milling campaigns. Upon further review with Mill staff, it is apparent that the 1998 dose maximum was elevated for workers in the unloading (dump station) area during the processing of alternate feed material. In this instance the CEDE[12] (Committed Effective Dose Equivalent the dose due to internal deposition) was the greatest contributor for the maximum case indicating that the inhalation pathway had the greatest influence. While the maximum dose for the 1998 1.41 rem was slightly above the ALARA objective (25% of the dose limit or 1.25 rem), all doses were well below the 5 rem maximum worker exposure limit, and the average was well below the ALARA goal. It is also important to note that processing of alternate feeds during the years 1997, 1999, 2002, 2003 and were well below that ALARA 25% objective, including 1999 when Colorado Plateau ores were also processed.

[12] Committed Effective Dose Equivalent (H_E50) is the sum of the products of the weighting factors applicable to each of the body organs or tissues that are irradiated and the committed dose equivalent to each of these organ tissues ($H_E50 = S \times W_t \times H_{t,50}$).

i) Area Contamination Monitoring

Denison carries out alpha surveys on a routine basis at various locations around the Mill. The results of these surveys are compared to the unrestricted release criterion of 5,000 dpm/100cm^2 total and 1,000 dpm/100 cm^2 removable alpha as set out in NRC Reg Guide 1-86, *Guidelines for Decontamination of Facilities and Equipment Prior to Release for Unrestricted Use or Termination of Licenses for Byproduct, Source and Special Nuclear Material.* To date, there has never been any indication of a trend suggesting any increase in contamination. Where elevated levels of contamination have been identified, they have been determined to be the result of inadvertent cross contamination from clothing. In such situations the Mill has taken corrective actions, including reminding the employees to observe good hygiene work practices. It is believed that good operational contamination controls supported by area contamination monitoring contributes to the low doses to workers seen at the Mill.

3.13.2.9 Radiological Impact on Biota Other Than Man

The 1978 ER (Section 5.1.3) considered the potential radiological impacts of radioactivity on "biota other than man" (non-human biota) and concluded that because of the low levels of airborne radioactivity that would be deposited on the ground arising from the operation of the Mill, no detrimental effect on non human biota would be expected.

The FES (Section 4.7.7) concluded that because the effluents from the Mill would be maintained within radiological protection limits for humans, there would be no adverse radiological impact on non-human biota such as birds and mammals.

This view was consistent with the generally held view of the time as expressed in the 1977 *Recommendations of the International Commission on Radiological Protection* (ICRP 1977) which indicated that "...the level of safety required for the protection of all human individuals is thought likely to be adequate to protect other species..."

It was only in the early 1990's that attempts were made to look in general at the effects of radiation on plants and animals at levels implied by the radiation protection standards for humans (e.g. IAEA 1992). More recently, The International Atomic Energy Agency (IAEA), amongst many other activities world-wide, made a start towards developing a protection methodology with a discussion document (IAEA 1999).

Recently, DOE has reviewed the available literature and evaluated dose benchmarks (actually dose-rate benchmarks) for non-human biota. (DOE 2002)

Given that there are no discharges to surface or groundwater from Mill operations and that neither the soil nor vegetation monitoring programs show any increasing trend, no impacts to non-human biota is expected from these sources.

3.13.3 Mill's Alternate Feed Program

In addition to allowing for the processing of conventionally mined ores for the recovery of uranium and vanadium, the Mill License gives the Mill the right to process other uranium-bearing materials known as "alternate feed materials," pursuant to the Alternate Feed Guidance referenced in Section 4 of the Application. Alternate feed materials are uranium-bearing materials other than conventionally mined uranium ores, such as residues from other processing facilities, which usually are classified as waste products to the generators of the materials. An amendment to the Mill License is required for each different alternate feed material. The Mill can process these uranium-bearing materials and recover uranium, alone or together with other valuable metals such as niobium, tantalum and zirconium.

Since the exact nature of future alternate feed material is unknown at the time of this writing, this ER's focus is appropriately directed at the upper bound and range of known natural ore mill feeds. Once a proposed alternate feed material is identified and properly characterized (and the milling processes to be applied to the feed are determined) the materials are evaluated carefully by Denison.

Alternate feed materials are acceptable for processing at the Mill if they meet the criteria set out in NRC's Alternate Feed Guideline and a specific license amendment authorizing receipt and processing of the Alternate Feed Material at the Mill is issued by the Executive Secretary. In reviewing a proposed Alternate Feed Material, the Mill and the Executive Secretary must determine on a case-by-case basis whether the proposed feed material can be processed at the Mill in a manner that does not give rise to any significant public health, safety, or environmental impacts, over and above the previously licensed activities.

As of February 28, 2007, the Mill has received fourteen license amendments, authorizing the Mill to process eighteen different alternate feed materials. As of February 28, 2007, the Mill has processed over 360,000 tons of alternate feed materials, recovering over 1.6 million pounds of U_3O_8 from these materials.

Table 3.13-19 sets out the sources of alternate feed materials and their source material content that have been licensed to date for processing at the Mill.

Table 3.13-24
Alternate Feed Materials Licensed to Date for Processing at the Mill

Alternate Feed	Description	Volume	Average Uranium Content (Wt % U)
Linde[1]	Soils contaminated with uranium and other radionuclides	100,000 tons	0.07%
Ashland [1]	Soils contaminated with uranium and other radionuclides.	172,600 tons	0.06%
Ashland[1]	Soils contaminated with uranium and other radionuclides.	43,980 tons	0.009%
St. Louis [1,2]	Soils contaminated with uranium and other radionuclides.	1,029,000 CY	0.09%
Maywood[1,3]	Soils contaminated with Th-232, uranium and other radionuclides.	250,000 Tons	0.01%.
Nevada Test Site Cotter Concentrate[4]	Drummed slurry	363 tons	10.0%
Honeywell[5]	Calcium Fluoride waste stream – licensed source material	5,443 tons	2.0%
Cabot[6]	Ore residues from tantalum production Licensed source material	16,830 tons	0.343%
Allied Signal[5]	Aqueous potassium hydroxide (KOH) slurry and solids Licensed source material	1,595 tons	17.0%
Rhone-Poulenc[5]	Uranyl nitrate hexahydrate liquid concentrate	17 tons	50.0%
Cameco[5]	Potassium fluoride product	1,966 tons	4.6%
Cameco[5]	Uranium tetrafluoride with filter ash Powdered solid	10 tons	65%
Cameco[5]	Calcined raffinate	2,197 tons	5.5%
Cameco[5]	Mono- and dibutyl phosphate regeneration product	557 tons	8.0%
W.R. Grace[2, 7]	Monazite sands and soils	203,000 tons	0.74%
Heritage[8]	Monazite sands	2,910 tons	0.05%
Molycorp[6]	Lead sulfide pond solids. Licensable source material	11,500 tons	0.15%
FMRI[8]	Ore residues from tantalum production Licensed source material	32,000 tons	0.15%

Source: Denison

[1] These FUSRAP materials are derived from uranium mill tailings. Therefore, they contain the U-238 series in disequilibrium

[2] Material that the Mill is licensed to process, but which the Mill has not received to date.

[3] Contains U-238 series in equilibrium and Th-232 series in disequilibrium.

[4] Contains U-238, low levels of Ra-226 and high levels of Th-230

[5] Contains U-238 series in disequilibrium

[6] Contains U-238 series in equilibrium as well as Th-232 series in equilibrium.

[7] Contains U-238 series in equilibrium with high levels of Th-232 and Th-228.

[8] Contains U-238 series in equilibrium, as well as elevated levels of Th-232 series in equilibrium.

4. ACCIDENTS

The occurrence of accidents related to operation of the Mill is minimized through proper design, construction, and operation of the process components and through a quality assurance program designed to establish and maintain safe operations. In accordance with applicable regulations, the facility design, the organization of the operation, and the quality assurance program, together with the 1978 ER and supplements were reviewed by various agencies to ensure that there is a basis for safe operations at the site. This review resulted in the FES. Additional evaluation of the environmental impacts of accidents was performed in the 1997 EA, with the benefit of information and data from many years of Mill operations. Moreover, several agencies maintain surveillance over the plant and its individual safety systems by conducting periodic inspections of the facility and its records and by requiring reports of effluent releases and deviations from normal operations.

Despite the above precautions, accidents involving the release of radioactive materials or harmful chemicals have occurred at other facilities in operations similar to those at the Mill. These potential accidents, as they relate to Mill operations generally, have been evaluated in the FES and in the 1997 EA. Because the proposed Mill operations will not change upon renewal of the License from those already accepted under the License, there will be no new situations involving potential accidents that have not been analyzed and adequately addressed in Mill design, in Mill procedures and in the training of Mill personnel and contractors. In accordance with Appendix A to NUREG 1569, an assessment of impacts from previously analyzed accidents is not required where the circumstances associated with such accidents have not changed.

The potential accidents previously assessed and accepted under the License include leakage of pipes or tanks, fires and explosions, tornadoes, tailings dam failure and failure of chemical storage tanks and transportation accidents. All of those types of accidents are discussed in more detail in the Application. There are no changes to applicable circumstances that would require a re-evaluation of those types of accidents in connection with this License renewal.

Furthermore, the GWDP has added a number of additional precautions and controls. These additional protections, together with the protections under the License are considered to be adequate to handle any accidents that may occur.

5. COSTS AND BENEFITS

Appendix A to NUREG 1569 requires that the applicant for a license renewal describe any updates and changes to the economic costs and benefits for the facility since the last application.

There have been no significant changes to the costs associated with the Mill since the last License renewal in 1997. There will be no change to the disturbed area or facilities or operations at the Mill as a result of the License renewal. As indicated in Section 3 of this ER, the Mill has operated in accordance with applicable regulatory standards and ALARA goals since its inception, and updated MILDOS AREA modeling indicates that the Mill is capable of continuing to operate well within those standards and goals. There have been no significant demographic changes that have impacted the ability of the Mill to operate in a manner that will result in no significant impacts to public health, safety or the environment. It is expected that continued Mill operations will continue to draw primarily upon the existing work force in the area with little impact on social services.

The Mill is one of only two operating uranium mills in the United States and is one of the largest private employers in San Juan County. The benefits of the Mill will continue to be the provision of well-paying jobs to workers in San Juan County and the support of the tax base in that County. Moreover, as the only operating uranium mill on the western slope of the Rocky Mountains, the Mill is relied upon by the large number of independent uranium miners in San Juan County and the Colorado Plateau as the only feasible uranium mill for their uranium ores. With the recent gap between the supply and demand for uranium and the increases in the price of uranium, the need for continued licensing of the Mill is crucial for such miners and for the uranium industry in the United States as a whole.

In sum, the costs associated with the operation of the Mill have not changed significantly, but the benefits have become more evident over time as the number of uranium mills has dwindled and the demand for uranium milling services from local miners and the industry as a whole has increased.

6. CONSIDERATION OF LONG TERM IMPACTS

The long term impacts, including decommissioning, decontamination, and reclamation impacts associated with activities to be conducted pursuant to the License have been considered in detail in the FES, the Mill's Reclamation Plan and the 2000 EA prepared by the NRC in connection with the Reclamation Plan.

The Mill's Reclamation Plan and financial surety arrangements, as well as the provisions in the Mill's GWDP that relate to final reclamation of the site are described in detail in Section 8 of the Application. The renewal of the License will not result in any changes to operations at the Mill that would impact decommissioning, decontamination or reclamation aspects associated with Mill activities, or the previous analyses of such aspects.

In other words, there will be no long term impacts associated with renewal of the License over and above those contemplated in connection with the existing License at the time it was last renewed in 1997.

7. MITIGATION OF IMPACTS

NUREG 1569 requires that the ER provide the "results of effectiveness of any mitigation proposed and implemented in the original license". In the case of the White Mesa Mill, there have not been any mitigations proposed or implemented under the License.